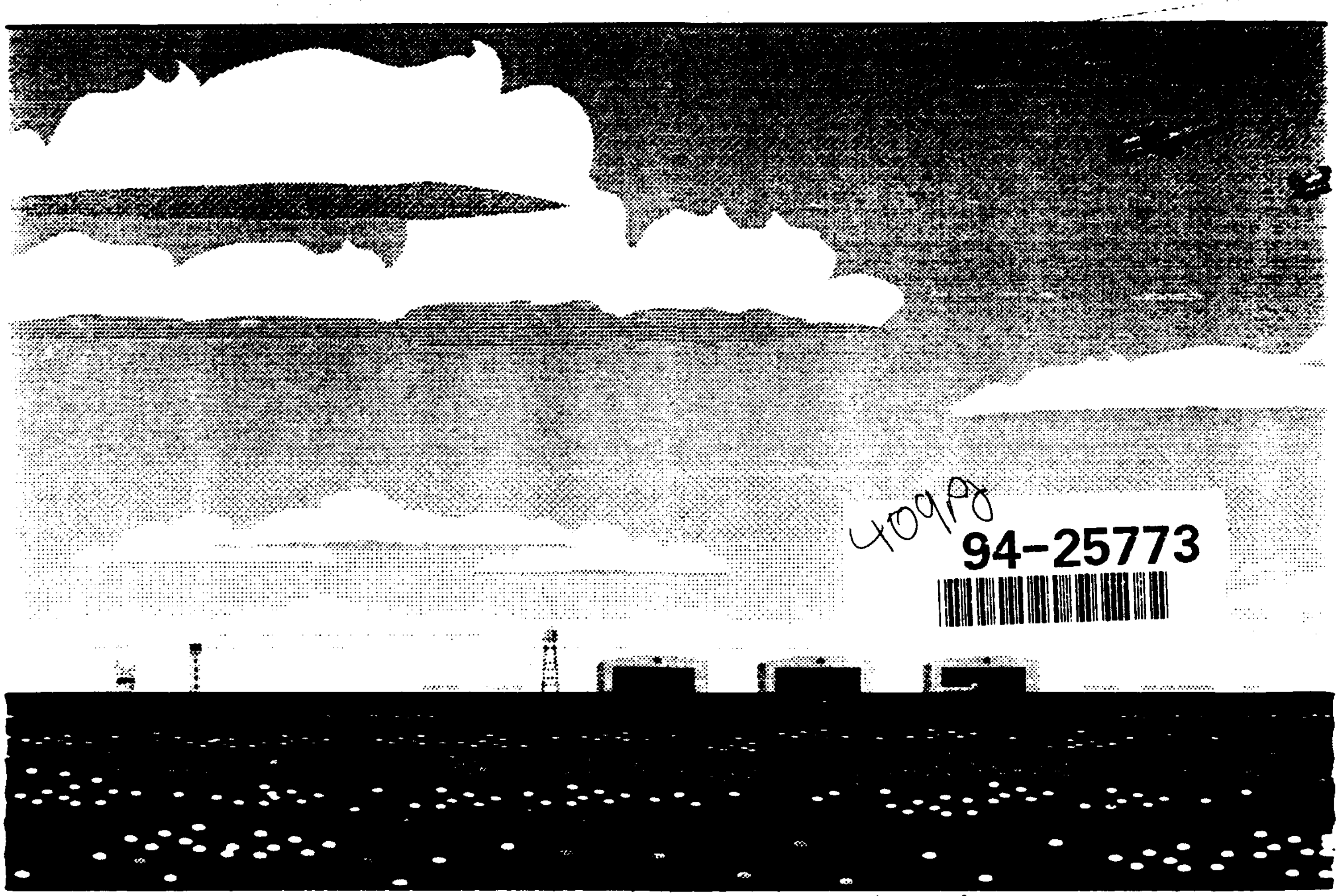
Installation Restoration Program (IRP)

FFF-13 0

Operable Unit C Remedial Investigation/Feasibility Stud Sampling and Analysis Plan

FINAL

May 1994



McClellan Air Force Base

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RADIAN
CORPORATION

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FAX # (916) 362-2318

3 May 1994

Russell Lowe
(F0469993D0018/8000)
SM-ALC/EM-CPM
3200 Peacekeeper Way, Suite 11
McClellan AFB, CA 95652-5590

SUBJECT: Submission of Deliverable
Final Copy OU C SAP

Dear Mr. Lowe:

Enclosed you will find insert pages for the Final copy of the OU C RI SAP. The enclosed pages replace those with the same page numbers in the Draft Final copy of the SAP. The cover and spine for the document should also be replaced. Four sets of the insert pages have been sent to your attention. With your concurrence, two sets each have been sent to Joe Healy of U.S. EPA and Mark Malinowski of DTSC. One set each has been sent to Dennis Bane of URS and Alex MacDonald of RWQCB.

If you have any questions, please call us at (916) 362-5332.

Sincerely,

Jane Faria
Jane Faria
Technical Manager

Greg Spadorcio
Gregory A. Spadorcio
Contract Manager

Enclosures

c: Paul Sears (SM-ALC/PKOP)
Kevin Wong (MS-ALC/EMR-RPM)
Dennis Bane (URS)
Joe Healy (U.S. EPA)
Mark Malinowski (DTSC)
Alex MacDonald (RWQCB)
Vic Auvinen
Greg Spadorcio
Project File (Delivery Order 8000)

INSTALLATION RESTORATION PROGRAM (IRP)

OPERABLE UNIT C REMEDIAL INVESTIGATION SAMPLING AND ANALYSIS PLAN

FINAL COPY

FOR

McCLELLAN AFB/EM
McCLELLAN AFB, CALIFORNIA 95652-5990

May 1994

USAF CONTRACT NO. F04699-93-D-0018, DELIVERY ORDER NO. 8000
CONTRACTOR CONTRACT NO. 602-100, DELIVERY ORDER NO. 8000

NOTICE

This report has been prepared for the Air Force by Radian Corporation for the purpose of aiding in the implementation of a final remedial action plan under the Air Force Installation Restoration Program (IRP). As the report relates to the initial screening of remedial action alternatives, its release prior to an Air Force final decision on remedial action may be in the public's interest. The limited objectives of this report and the ongoing nature of the IRP, along with the evolving knowledge of site conditions and chemical effects on the environmental and health, must be considered when evaluating this report, since subsequent facts may become known that may make this report premature or inaccurate. Acceptance of this report in performance of the contract under which it is prepared does not mean that the Air Force adopts the conclusions, recommendations, or other views expressed herein, which are those of the contractor only and do not necessarily reflect the official position of the Air Force.

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS SACRAMENTO AIR LOGISTICS CENTER (AFMC)
McCLELLAN AIR FORCE BASE, CALIFORNIA

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MAY 2 1994
ENVIRONMENTAL RESTORATION FILE

1994

MEMORANDUM FOR SEE DISTRIBUTION

FROM: SM-ALC/EMR
5050 Dudley Blvd, Suite 3
McClellan AFB CA 95652-1389

SUBJECT: Operable Unit C Sampling and Analysis Plan (OUC SAP) - ACTION MEMORANDUM

1. The Operable Unit C Sampling and Analysis Plan (OUC SAP) had gone final on 30 Mar 94, thirty days after submittal of the Draft Final Plan, in accordance with Section 7.9 of the IAG. We have since received additional comments that warrant incorporation into the OUC SAP. Attached are the revised pages and new cover of the OUC SAP (atch 1). Please replace the corresponding pages and cover of the Draft Final Report you have with the inserts to both reflect the changes from draft final to final status and the incorporation of the additional comments.

2. If you have any questions or concerns, please do not hesitate to contact Kevin Wong or Russ Lowe at (916) 643-0830.

Kendal R. Tanner

KENDAL R. TANNER, P.E.
Remedial Program Manager
Environmental Restoration Division
Environmental Management Directorate

Attachment
1. SAP Inserts

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
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10389 Old Placerville Road
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McClellan AFB, California 95652-1036

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13. ABSTRACT (Maximum 200 words)

This document presents the technical approach for sampling and analysis activities in Operable Unit C of McClellan Air Force Base (AFB). Individual Field Sampling Plans (FSPs) include data quality objectives, sampling and analysis matrix tables, and sampling location figures and tables.

14. SUBJECT TERMS

15. NUMBER OF PAGES

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PREFACE

Radian Corporation is the contractor for the RI/FS program at McClellan AFB, California. This work was performed for the Sacramento Air Logistics Center (SM-ALC/EMR) under Air Force Contract No. F04699-93-D-0018, Delivery Order 8000.

Key Radian project personnel were:

William E. Corbett — Corporate Sponsor
Victor T. Auvinen — Project Manager
Gregory A. Spadorcio — Contract Manager
Tyler P. Thompson — Delivery Order Manager
Jane Faria — Technical Manager

Radian would like to acknowledge the cooperation of the McClellan AFB Office of Environmental Management. In particular, Radian acknowledges the assistance of Kevin Wong and Russell Lowe.

The work presented herein was accomplished between May 1993 and May 1994. Mr. Russell Lowe, SM-ALC/EMR, was the Contracting Officer's Technical Representative.

This report has been prepared by the staff of Radian Corporation under my supervision. The presentation of information contained herein has been approved after thorough technical review. Recommendations in this report are based upon data compiled from previous reports and Air Force files. The interpretation of these data and the conclusions drawn were governed by my experience and professional judgment.

Thomas F. Cudzilo

Thomas F. Cudzilo, Ph.D
Registered Geologist 4473

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ACRONYMS USED IN THIS REPORT

AFB	=	Air Force Base
ARAR	=	Applicable or Relevant and Appropriate Requirement
ASTM	=	American Society for Testing and Materials
AVOC	=	Aromatic volatile organic compound
BGS	=	Below ground surface
BTEX	=	Benzene, toluene, ethylbenzene, and xylene
BW	=	Base Well
CE	=	Civil Engineering
CERCLA	=	Comprehensive Environmental Response, Compensation, and Liability Act
COC	=	Contaminant of concern
CS	=	Confirmed Site
CV	=	Coefficient of variation
CW	=	City Well
DCA	=	Dichloroethane
DCE	=	Dichloroethene
DEB	=	Deep exploration boring
DERP	=	Defense Environmental Restoration Program
DOD	=	Department of Defense
DQO	=	Data quality objective
DRMO	=	Defense Reutilization and Marketing Office
DTSC	=	Department of Toxic Substance Control
EE/CA	=	Engineering Evaluation/Cost Analysis
EM	=	Environmental Management
EMR	=	Environmental Management Restoration Division
EPIC	=	Environmental Process Improvement Center
E-TPH	=	Extractable total petroleum hydrocarbon
EW	=	Extraction Well
FGC	=	Screening analysis of soil gas for commonly detected VOCs with on-site gas chromatograph
FGC	=	Field gas chromatograph
FID	=	Flame ionization detector
FML	=	Field metals lab
FS	=	Feasibility Study
FSP	=	Field Sampling Plan

ACRONYMS (Continued)

GC	=	Gas chromatograph
GPR	=	Ground penetrating radar
GSAP	=	Groundwater Sampling and Analysis Plan
GW	=	Groundwater
GWMW	=	Groundwater monitoring well
GWPZ	=	Groundwater piezometer
GWTP	=	Groundwater Treatment Plant
HI	=	Hazard Index
HPDE	=	High density polyethylene
HRA	=	Health risk assessment
HSA	=	Hollow stem auger
HSP	=	Health and Safety Plan
HSVOC	=	Halogenated semivolatile organic compound
HVOC	=	Halogenated volatile organic compound
HQ	=	Hazard quotient
IAG	=	Interagency Agreement
IC	=	Investigation Cluster
ICP	=	Inductively Coupled Plasma
IPCB	=	Immunoassay test for polychlorinated biphenyls
IRP	=	Installation Restoration Program
IWL	=	Industrial Wastewater Line
IWTP	=	Industrial Wastewater Treatment Plant
LEL	=	Lower explosive limit
LOC	=	Level of concern
MCL	=	Maximum contaminant level
MDRD	=	Minimum detectable relative difference
mg/kg	=	Milligrams per kilogram
mg/L	=	Milligrams per liter
mg/yr	=	Milligrams per year
MSL	=	Mean sea level
MW	=	Monitoring Well
NA	=	Not applicable
NCP	=	National Oil and Hazardous Substances Pollution Contingency Plan
NEPA	=	National Environmental Policy Act
NFI	=	No further investigation

ACRONYMS (Continued)

NPDES	=	National Pollutant Discharge Elimination System
NPL	=	National Priority List
NS	=	Not sampled
NSVOC	=	Nonhalogenated semivolatile organic compound
NVOC	=	Nonhalogenated volatile organic compound
OU	=	Operable Unit
OVA	=	Organic vapor analyzer
PA	=	Preliminary Assessment
PAH	=	Polycyclic aromatic hydrocarbon
PCB	=	Polychlorinated biphenyl
PCE	=	Tetrachloroethene
pCi/g	=	Picocuries per gram
PID	=	Photoionization detector
PP	=	Proposed Plan
ppb	=	Parts per billion
ppbv	=	Parts per billion by volume
ppmv	=	Parts per million by volume
PRL	=	Potential Release Location
PVC	=	Polyvinyl chloride
QAPP	=	Quality Assurance Project Plan
RA	=	Remedial action
RCRA	=	Resource Conservation and Recovery Act
RD	=	Remedial Design
RI/FS	=	Remedial Investigation/Feasibility Study
RI	=	Remedial Investigation
ROD	=	Record of Decision
ROI	=	Radius of Influence
SACM	=	Superfund Accelerated Cleanup Model
SAP	=	Sampling and Analysis Plan
SHRA	=	Screening health risk assessment
SI	=	Site Investigation
SOP	=	Standard Operating Procedure
STLC	=	Soluble threshold limit concentration
SVE	=	Soil vapor extraction
SVMW	=	Soil vapor monitoring well

ACRONYMS (Continued)

SVOC	=	Semivolatile organic compound
SW	=	Solid waste analytical method from U.S. EPA SW846
SWAT	=	Solid waste assessment test
TC	=	Toxicity characteristic
TCA	=	Trichloroethane
TCE	=	Trichloroethene
TCLP	=	Toxicity characteristic leaching procedure
TIS	=	Technical Information System
TPH	=	Total petroleum hydrocarbons
UPRL	=	Unstudied Potential Release Location
U.S. EPA	=	United States Environmental Protection Agency
UST	=	Underground storage tank
UVOC	=	Unidentified volatile organic compound
VOC	=	Volatile organic compound
V-TPH	=	Volatile total petroleum hydrocarbon
VZM	=	Vadose zone model
WIMS	=	Work Information Management System
µg/kg	=	Micrograms per kilogram
µg/L	=	Micrograms per liter

1.0 INTRODUCTION

In 1979, McClellan Air Force Base (AFB) officials began to suspect that past waste disposal practices may be contaminating groundwater. Acting in a proactive manner, McClellan AFB established a groundwater contamination committee that identified at least four areas of potential groundwater contamination requiring further investigation. Subsequent investigations confirmed suspected contamination, and McClellan AFB developed a comprehensive program to maintain drinking water quality and to remediate contamination.

In 1981, the United States Department of Defense (DOD) developed the Installation Restoration Program (IRP) to investigate hazardous material disposal sites on DOD facilities; McClellan AFB's comprehensive program was revised to conform with the IRP. Since then, numerous investigations and studies have been performed at McClellan AFB under the IRP.

On 22 July 1987, McClellan AFB was placed on the U.S. Environmental Protection Agency's (U.S. EPA) National Priorities List (NPL). In May 1990, the Air Force, U.S. EPA Region IX, and the California Department of Health Services (authority was transferred to the California EPA [Cal/EPA] in 1992) signed an Interagency Agreement (IAG) in accordance with the following authorities:

CERCLA § 120 (Comprehensive Environmental Response, Compensation, and Liability Act, as amended);

RCRA § 6001, 3000(h), 3000(u), and 3000(v) (Resource Conservation and Recovery Act, as amended);

NEPA (National Environmental Policy Act);

DERP (Defense Environmental Restoration Program);

Executive Order 12580; and

California Health and Safety Code § 102 and 25355.5(a)(1)(c), pursuant to RCRA § 3006.

The IAG also requires compliance with the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), CERCLA guidance and policy, RCRA guidance and policy, and applicable state laws. The IAG is a binding document which lists laws and regulations that McClellan AFB and the regulatory agencies must following during remediation efforts. In addition, the overall schedule for cleanup at McClellan AFB is documented in the IAG; however, the schedule can be updated as needed if all parties agree.

The McClellan AFB IRP program encompasses more than 250 areas under investigation. For the purpose of managing these investigations and developing efficient and coordinated response actions and remedial strategies, McClellan AFB has been divided into 10 operable units (OUs), the boundaries of which are shown in Figure 1-1. These OUs generally correspond to areas where specific industrial operations and waste management activities have historically occurred and are referred to as geographic source areas or vadose zone OUs. An eleventh OU has been designated as the contaminated groundwater underlying McClellan AFB; this OU facilitates basewide groundwater remediation efforts. Operable Unit C is the sixth OU that will be moved through the CERCLA process. The remedial investigation and feasibility study (RI/FS) at OU C will benefit from information learned during previous investigations at OUs A, B, B1, C1, and D and the Groundwater OU.

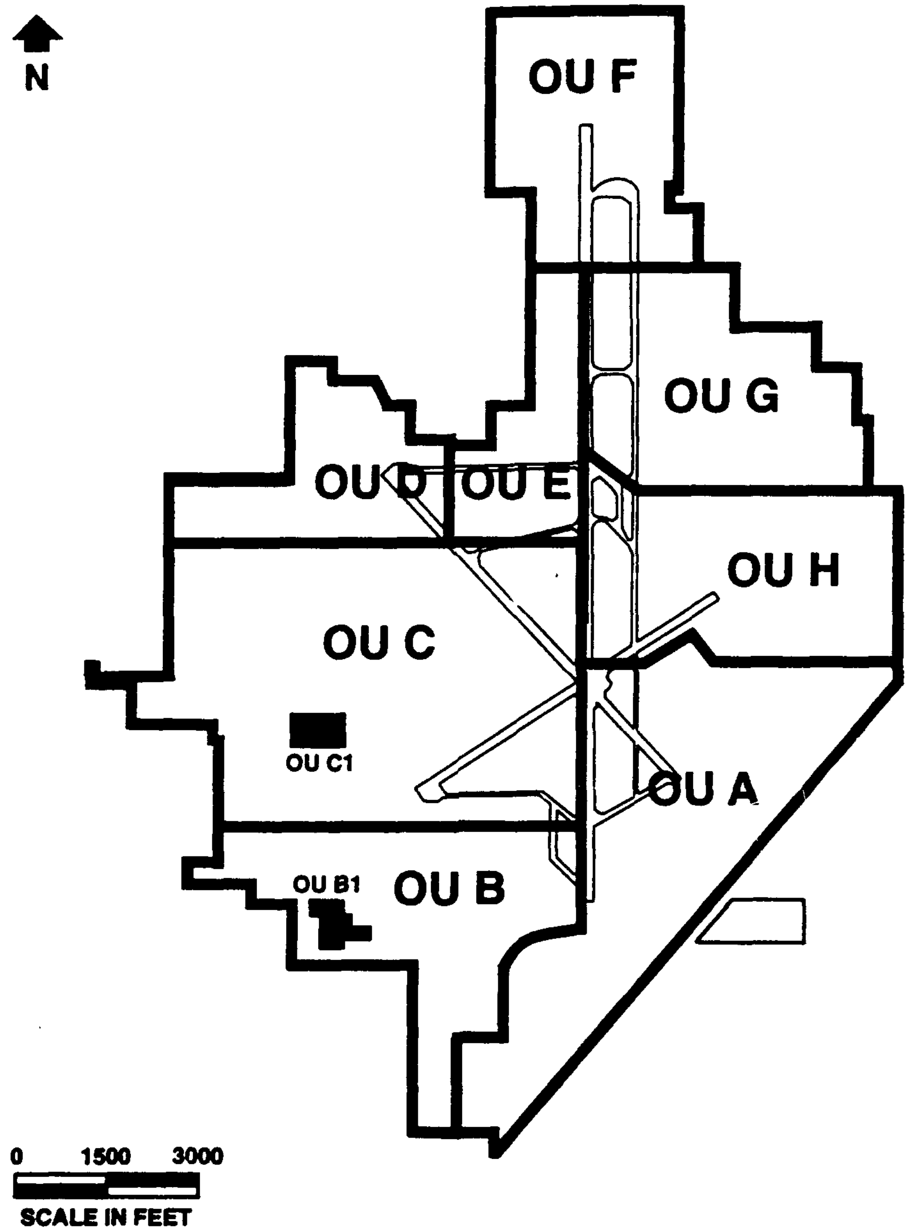


Figure 1-1. Boundaries of Operable Units at McClellan AFB

OUBOUND9.FH3 - VMG 9/293/93 SAC

The preliminary assessment phase of the CERCLA process has been completed for OU C (Figure 1-2); and the final OU C Preliminary Assessment Summary Report (CH2M HILL, 1993) identified 41 sites that will require further characterization. A comprehensive RI/FS will provide the basis for identification of sites requiring no further investigation and for selection of appropriate and feasible remedies for areas requiring cleanup in OU C.

1.1 McClellan AFB Remediation Strategy

McClellan AFB has recently reorganized its environmental program to optimize planning and execution of remedial efforts, while achieving the goal of protecting human health and the environment. McClellan AFB is tailoring its program to take advantage of the regulatory opportunities offered by the U.S. EPA's Superfund Accelerated Cleanup Model (SACM), and to incorporate the lessons learned from remediation efforts at other federal facilities and private party sites. *The McClellan AFB IRP remediation strategy is designed to support the McClellan AFB goal:*

> *Make optimal use of program resources in planning and executing remediation actions to achieve the goal of our customers, i.e., protect human health and the environment through cleaning up hazardous waste contamination. Optimal use of resources involves a complex process of balancing cost, program acceleration, cleanup levels, remedial measure alternatives, and community and regulatory interests to achieve a program that delivers the best possible value for the investment made.*

Figure 1-3 shows the conceptual process for the OU C RI/FS, Figure 1-4 shows how the OU C RI/FS will be incorporated with the McClellan AFB IRP strategy, and Figure 1-5 illustrates the overall RI/FS process and key decision points for OU C.

The purpose of this OU C RI SAP is to describe the field procedures, sample collection points, analytical methods, data handling and analysis, and decision-making criteria for the OU C RI. A summary of the objectives for the SAP are shown on Figure 1-4.

1.2 Coordination with Other Projects

The OU C RI/FS has been designed to integrate with other projects at McClellan AFB so that resources are utilized efficiently, work is performed in a consistent manner with previous projects, and lessons learned from other projects are applied to OU C. The following is a summary of the primary projects at McClellan AFB with which the OU C RI/FS will be integrated.

Groundwater OU RI/FS and Record of Decision (ROD)

From the initial planning phases of the RI through completion, the OU C and groundwater OU RI/FS teams will work together to identify data gaps to be filled during the OU C RI. HydroPunch® (or equivalent) samples will be collected and groundwater monitoring wells will be installed to further define the extent of groundwater contamination and source areas in OU C. Extraction wells and/or piezometers may also be installed during the RI to enhance the OU C groundwater extraction system and further define groundwater flow directions.

The OU C team will coordinate with the Groundwater OU team members to collect groundwater samples from OU C wells during the OU C RI.

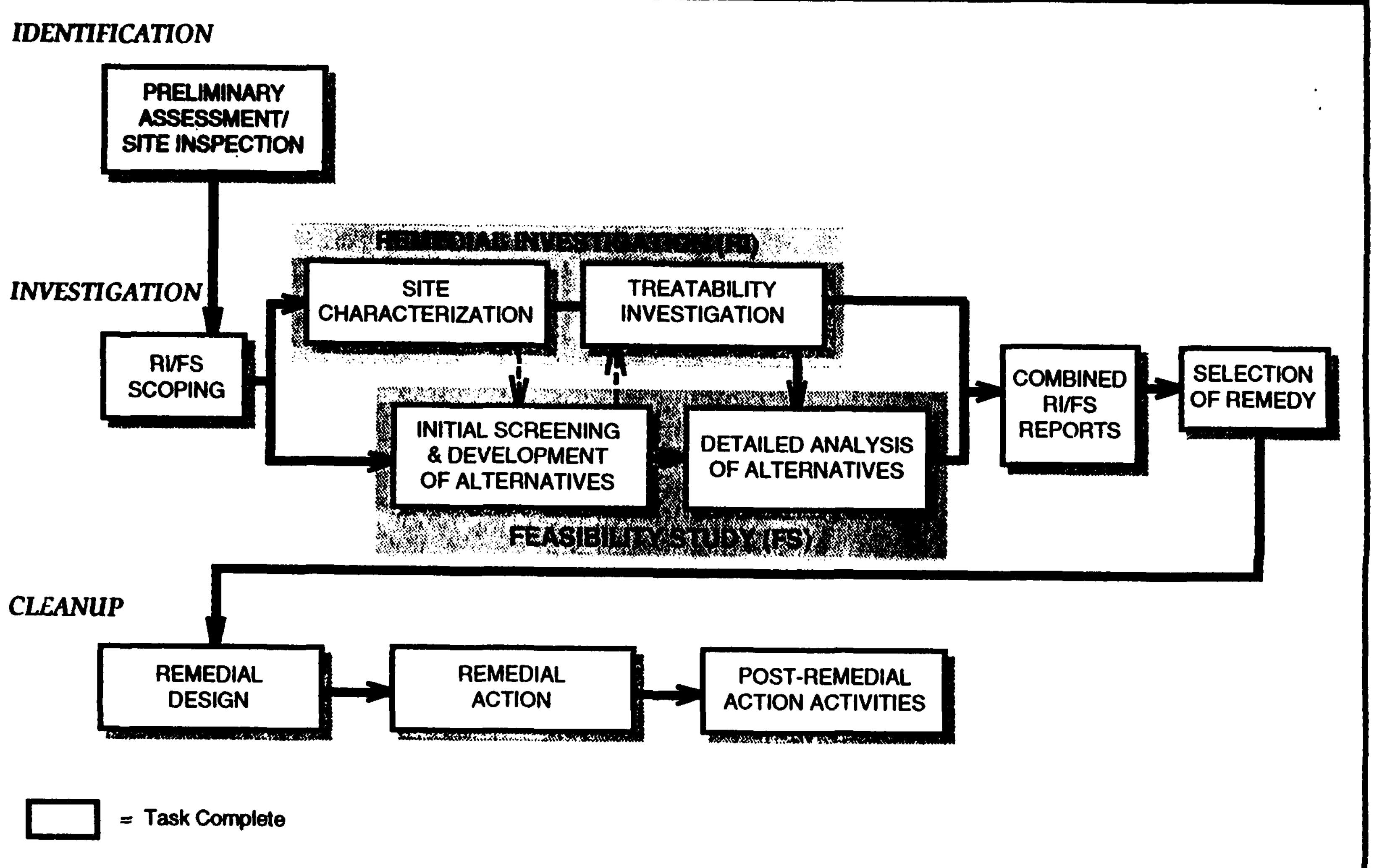


Figure 1-2. General CERCLA Remedial Response Process

CERCLA9.PM4 - VMG 10/20/89 SAC

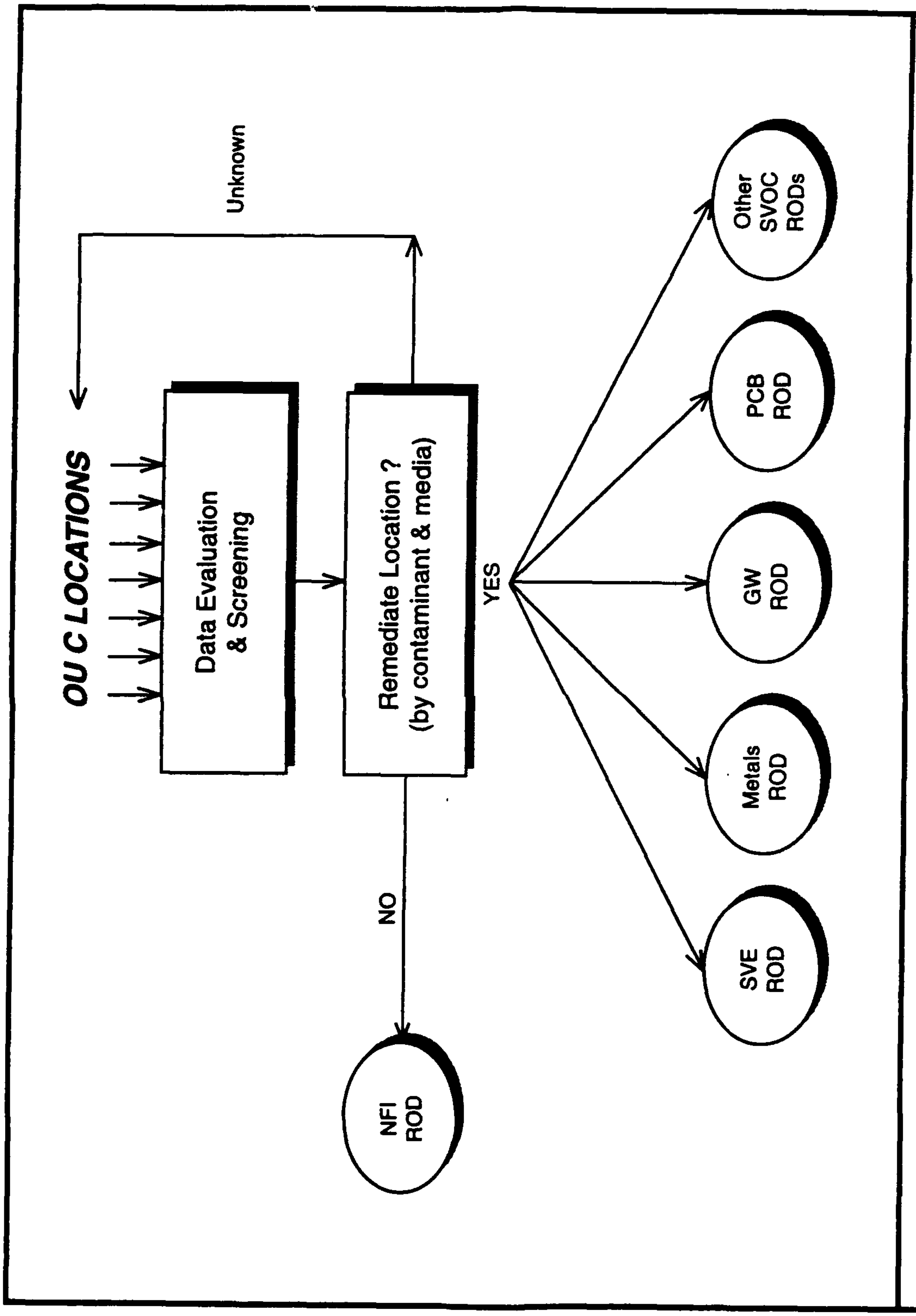


Figure 1-3. Operable Unit C RI/FS Process

OUCRIFS9.PM4 - VMG 10/20/93 SAC

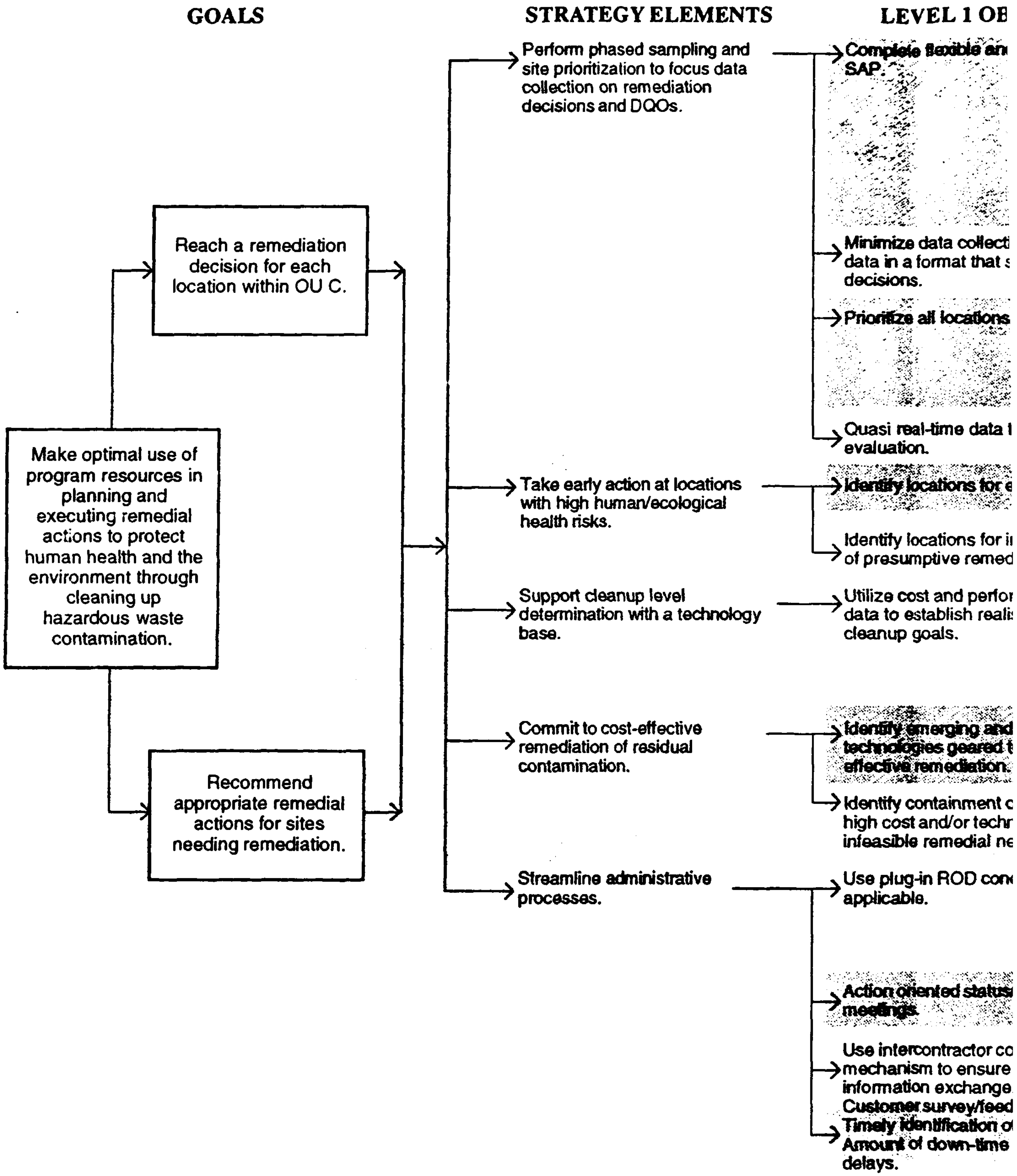
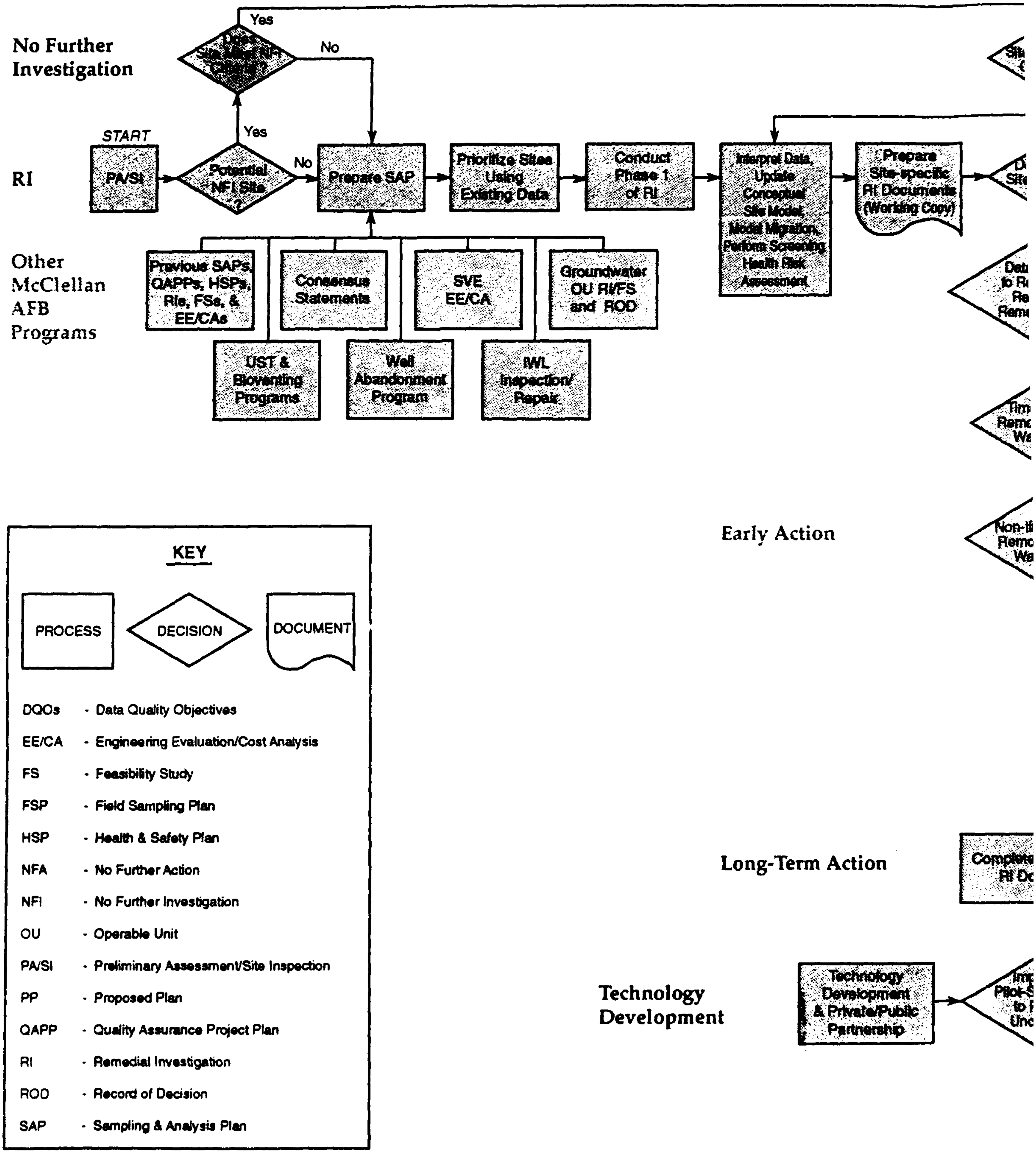


Table 1-4. Operable Unit C RI/FS Goals :

LEVEL 1 OBJECTIVES	LEVEL 2 OBJECTIVES	METRICS
Complete flexible and easy-to-use SAP.	Outline OU C RI/FS process. Establish general and site-specific DQOs. Maximize use of existing information. Maximize use of data analysis tools (TIS).	Customer (internal and external) Survey/feedback
Minimize data collection and present data in a format that supports remedial decisions.		Meeting DQOs; Compare to average cost for RI at DOD site.
Prioritize all locations.		Number of locations ranked; Movement of locations from one category to another (shows progress); Number of locations with remedial decisions (shows decisions).
Quasi real-time data turnaround and evaluation.		Time from sampling to access by customers.
Identify locations for early action.		Number of locations identified.
Identify locations for implementation of presumptive remedies.		Amount of risk reduction at implemented locations.
Utilize cost and performance data to establish realistic cleanup goals.	Use data from ongoing remedial/removal actions at McAFB and elsewhere.	Number of cleanup levels based on data other than ARARs/HRA.
	Identify candidate sites for treatability/pilot scale testing as early as possible.	Potential cost savings or avoidance.
Identify emerging and/or existing technologies geared toward cost effective remediation.		Number of technologies identified that are cost effective. Potential cost savings.
Identify containment options for high cost and/or technically infeasible remedial needs.		Number of options identified for containment. Potential cost savings.
Use plug-in ROD concept where applicable.	Basewide RI report.	Number of locations plugged into Basewide RI Report.
	Use plug-in remedial frameworks.	Number of locations plugged into existing EE/CAs and RODs.
Action oriented status/strategy meetings.		Customer survey/feedback.
Use intercontractor coordination mechanism to ensure effective information exchange. Customer survey/feedback. Timely identification of scope changes. Amount of down-time and schedule delays.		

C RI/FS Goals and Quality Measures

(2)


No Further Investigation
RI
Other McClellan AFB Programs
START
PA/SI
Potential NFI Site ?
Yes
No
Does Site Meet NFI Criteria ?
Yes
No
Prepare SAP
Prioritize Sites Using Existing Data
Conduct Phase 1 of RI
Interpret Data, Update Conceptual Site Model, Model Migration, Perform Screening Health Risk Assessment
Prepare Site-specific RI Documents (Working Copy)
Previous SAPs, QAPPs, HSPs, RIs, FSs, & EE/CAs
Consensus Statements
SVE EE/CA
Groundwater OU RI/FS and ROD
UST & Bioventing Programs
Well Abandonment Program
IWL Inspection/ Repair
Early Action
Long-Term Action
Technology Development
Technology Development & Private/Public Partnership
KEY
PROCESS
DECISION
DOCUMENT
DQOs - Data Quality Objectives
EE/CA - Engineering Evaluation/Cost Analysis
FS - Feasibility Study
FSP - Field Sampling Plan
HSP - Health & Safety Plan
NFA - No Further Action
NFI - No Further Investigation
OU - Operable Unit
PA/SI - Preliminary Assessment/Site Inspection
PP - Proposed Plan
QAPP - Quality Assurance Project Plan
RI - Remedial Investigation
ROD - Record of Decision
SAP - Sampling & Analysis Plan

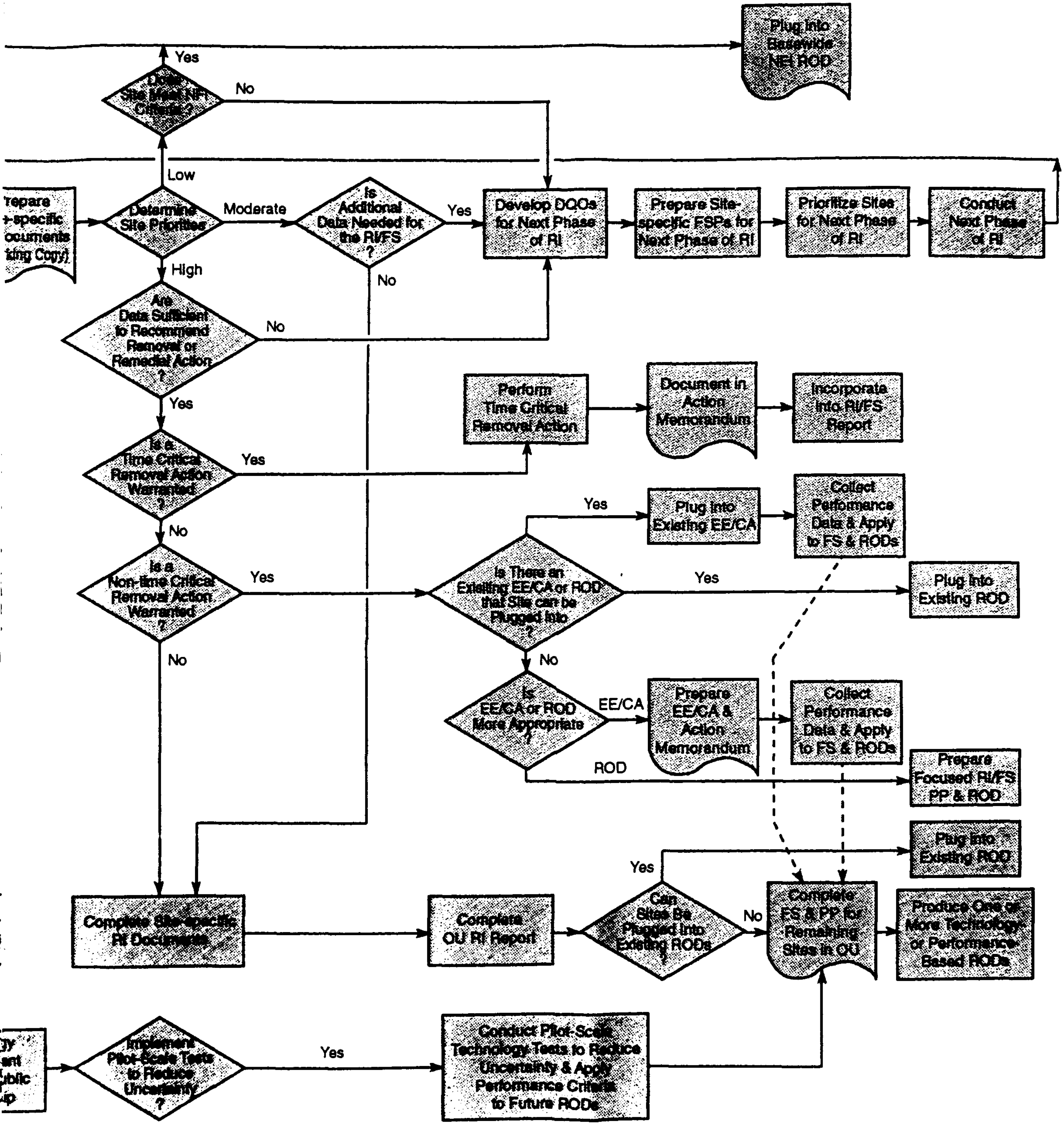


Figure 1-5..
Operable Unit C RI/FS Process Flow Chart

OUCFLO1.FH3 - VMG 2/25/94 SAC

2

Soil Vapor Extraction Removal Action

Soil vapor extraction is the presumptive remedy for volatile organic compounds in the vadose zone at McClellan AFB. The Soil Vapor Extraction (SVE) Engineering Evaluation and Cost Analysis (EE/CA) establishes criteria to determine if SVE is feasible and if early action is needed. The OU C team will work with the SVE removal action team to ensure adequate data are collected to identify possible SVE sites and determine if sites should be included in the removal action.

Consensus Statements

The OU C team will follow guidance documented in the consensus statements approved by the parties of the IAG. Consensus statements are designed to improve the overall quality and consistency of projects at McClellan AFB. *The OU C RI/FS will comply with the following Consensus Statements:*

- *Soil Gas Consensus Statement;*
- *Subsurface Soil Background Consensus Statement;*
- *Risk Assessment Consensus Statement; and*
- *No Further Investigation Consensus Statement.*

A consensus statement is currently being prepared for surface soil/sediment background concentrations. Standard operating procedures for conversion of boreholes to vapor extraction monitoring wells will be included in the forthcoming revision of the Quality Assurance Project Plan (QAPP). When these procedures are finalized, they will be incorporated into the OU C RI/FS.

Quality Assurance Project Plan

The OU C RI will follow the guidance and standard operating procedures (SOPs) described in the basewide QAPP. If additions to the QAPP are needed, SOPs will be prepared and used by all teams to ensure consistency between projects. The new SOPs will be added to Appendix B of the OU C RI SAP and to the Basewide QAPP.

Industrial Wastewater Line (IWL) Inspections

The OU C team will work with the IWL team to determine where leaks have been identified and where investigations should be focused along the IWL. If additional leaks in the IWL are located during the RI (main lines or feeder lines), recommendations for additional line inspections will be relayed to the IWL team.

Underground Storage Tank (UST) Program

Underground storage tanks will be investigated during the OU C RI. If only petroleum hydrocarbons are detected in the shallow vadose zone (less than 30 feet below ground surface), the tank will remain in the UST program and not be investigated further under the IRP program. All decisions will be reached by consensus by the parties of the IAG.

Bioventing Program

The OU C team will work with the bioventing team to determine candidate sites for the bioventing program at McClellan AFB.

Well Abandonment Program

Potential improperly abandoned wells and wells that may provide a conduit for vertical contaminant migration identified during the OU C RI will be brought to the attention of the Well Abandonment Team so they can be properly decommissioned.

1.3 Updates to the OU C RI SAP

As the current FSPs are implemented and data are collected, additional work will be planned to complete the RI/FS. The planning and review of this future work prior to implementation will be accomplished through the general logic framework presented in Figure 1-5. *When sufficient data have been generated to prioritize sites, a site-specific RI document will be prepared to summarize the RI findings. If, through the site prioritization process, it is determined that additional data are needed, a site-specific FSP will be prepared as an addendum to the OU C RI SAP.*

1.4 Acknowledgment of Previous Efforts

This SAP builds on previous work performed by Radian Corporation in OU B, OU B1, and the Preliminary Groundwater Operable Unit Remedial Investigation (Radian, 1991, 1992, and 1993); by Jacobs Engineering in OU A and OU C1 (Jacobs, 1992a and 1992b); by CH2M HILL in OU C and D (CH2M HILL, 1992); by MITRE Corporation for the Management Action Plan (McClellan AFB, 1993); by Radian Corporation for the Basewide Final QAPP (Radian, 1992); and by CH2M HILL for the Draft Groundwater OU RI/FS (CH2M HILL, 1993).

2.0 DESCRIPTION OF OPERABLE UNIT (OU) C

McClellan Air Force Base (AFB), an Air Force Logistics Command Center, is located approximately 7 miles northeast of downtown Sacramento, California and comprises approximately 3,000 acres (Figure 2-1). Operations include the management, maintenance, and repair of aircraft, electronics, and communications equipment. Operable Unit C is located in the western portion of McClellan AFB).

2.1 Surface Features

The surface features of OU C include open grassland, creeks, drainages, buildings, and aircraft taxiways.

2.1.1 Topography

The land surface of McClellan AFB is a relatively level plain, which slopes gently to the west (Figure 2-2). Surface elevation in OU C ranges from about 65 feet mean sea level (MSL) at the eastern boundary to about 50 feet MSL at the western boundary — a drop of 15 feet in elevation over approximately 1 mile. Prevailing winds are usually from the south to southeast (Figure 2-2).

Approximately 40% of OU C is covered by building foundations or pavement. Most of the buildings are located in the southern and central portions of OU C; the remaining area is open grassland with some vernal pools (Figure 2-3).

2.1.2 Surface Water

Surface water in the Sacramento area originates primarily from the Sierra Nevada mountain range to the east. The Sacramento and American Rivers are the major drainages in the vicinity of McClellan AFB.

Surface water in OU C drains toward and is discharged into Don Julio and Magpie creeks. Figure 2-4 shows the location of the creeks and the 100-year flood plain. The McClellan AFB storm drainage system, a network of underground pipes, culverts, and open drainage ditches, directs surface water runoff and rainfall to the creeks (Figure 2-5).

Magpie Creek originates off base to the east. Since the 1930s, it has conveyed surface water through industrial sections of McClellan AFB to OU C. The creek channel in OU C has been modified from its original course three times since 1945. Also since 1945, all water in Magpie Creek has been diverted through a skimming basin before flowing off base; since 1959, creek water has flowed through two oxidation ponds before leaving McClellan AFB. Much of the creek is lined with concrete and corrugated steel planking.

Don Julio Creek originates off base to the east (McClellan AFB, 1993b). The northern portion of the creek has been channelized since 1957 (parallel to Patrol Road) and flows from OU D to OU C. Small seasonal streams feed Don Julio Creek from the east. Both arms of the creek, north and east, join to flow off base to the west. A flood retention basin has been constructed recently in this area.

The western portion of OU C contains vernal pools. During the rainy season, rainwater collects in these pools and slowly infiltrates the surface. Water that does not percolate through the dense hardpan present beneath the pools evaporates during the spring and summer months.

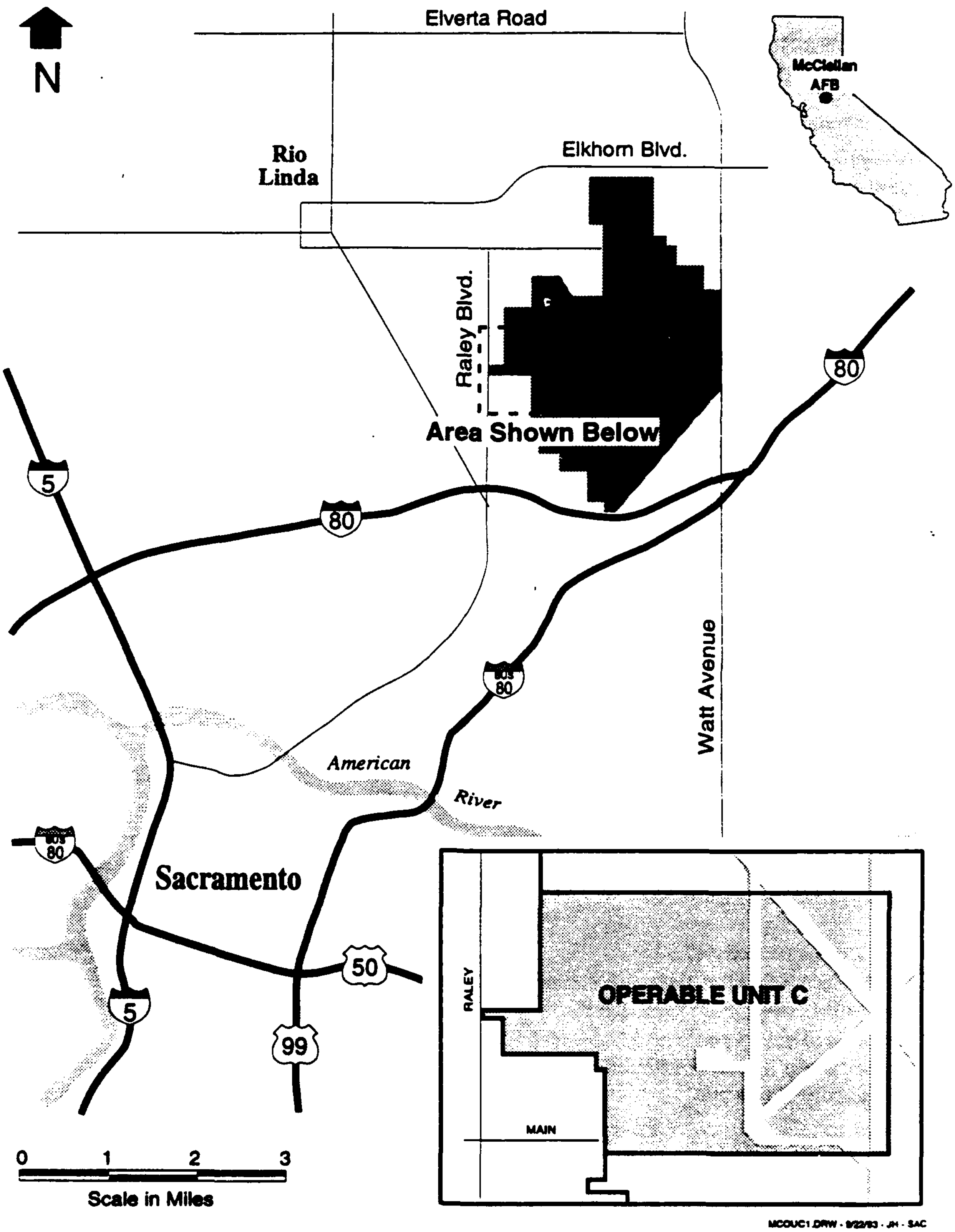


Figure 2-1. Location of McClellan Air Force Base and Operable Unit C

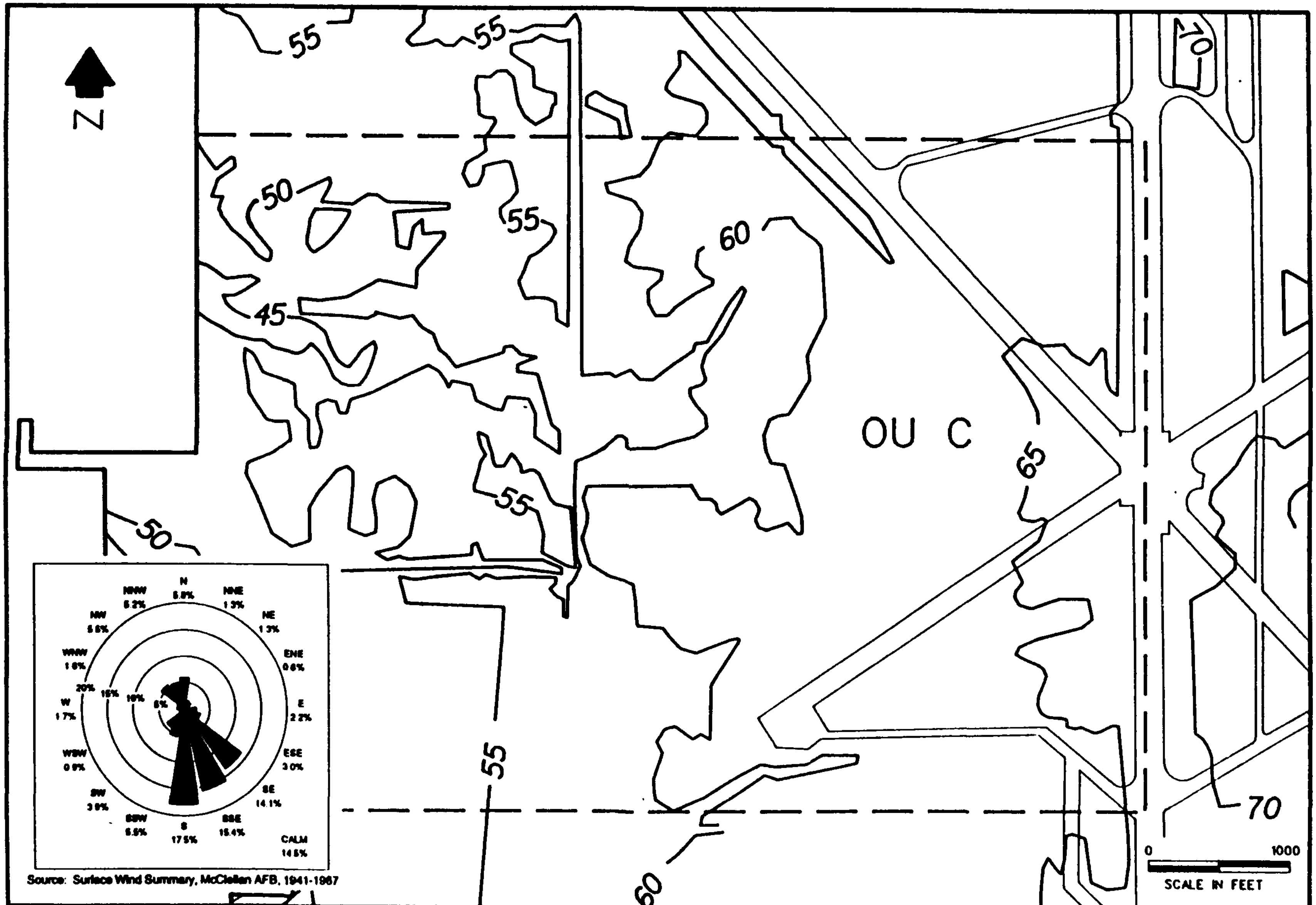


Figure 2-2 Topographic Map of OU C at McClellan AFB

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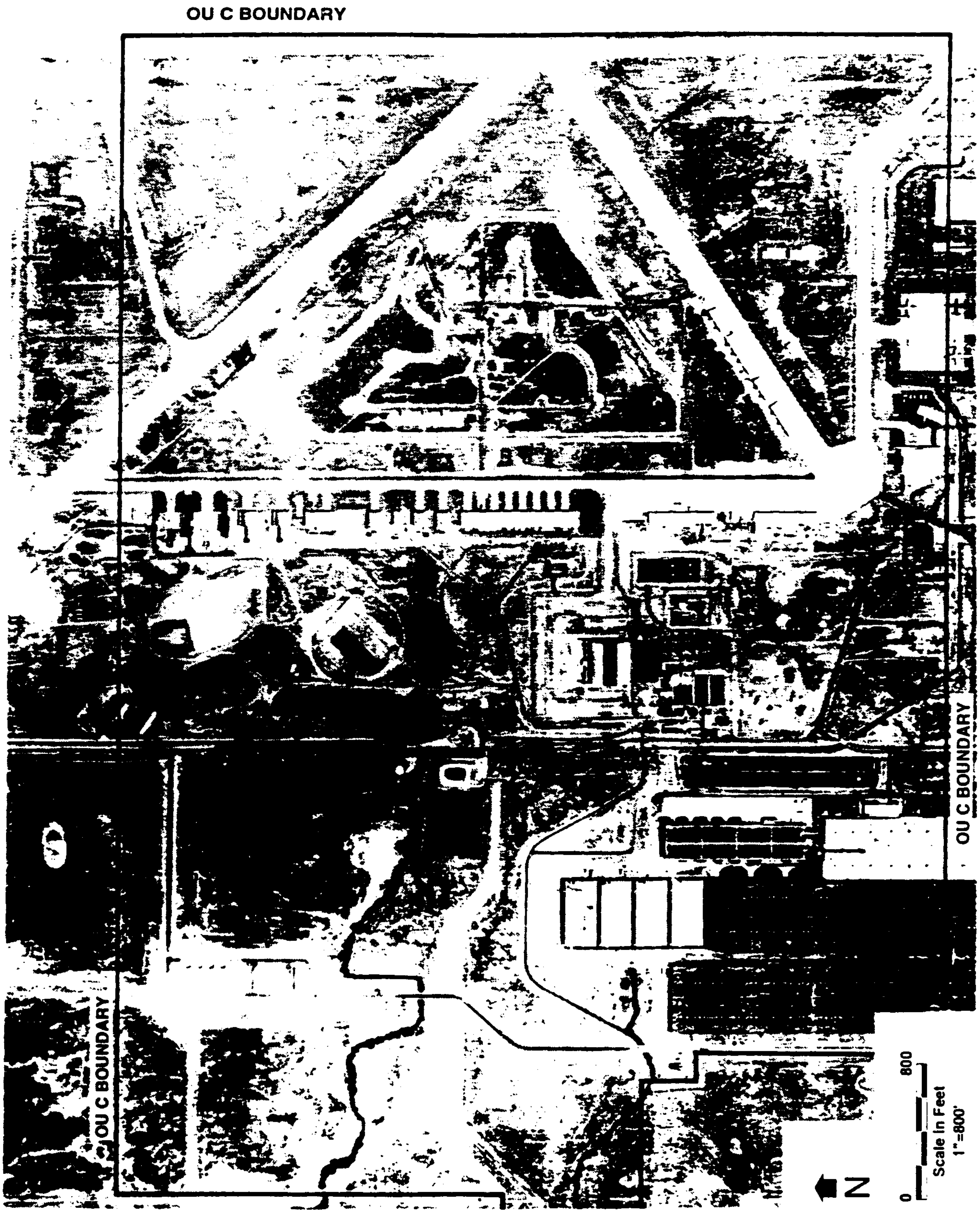

Figure 2-3. Aerial Photograph of OU C

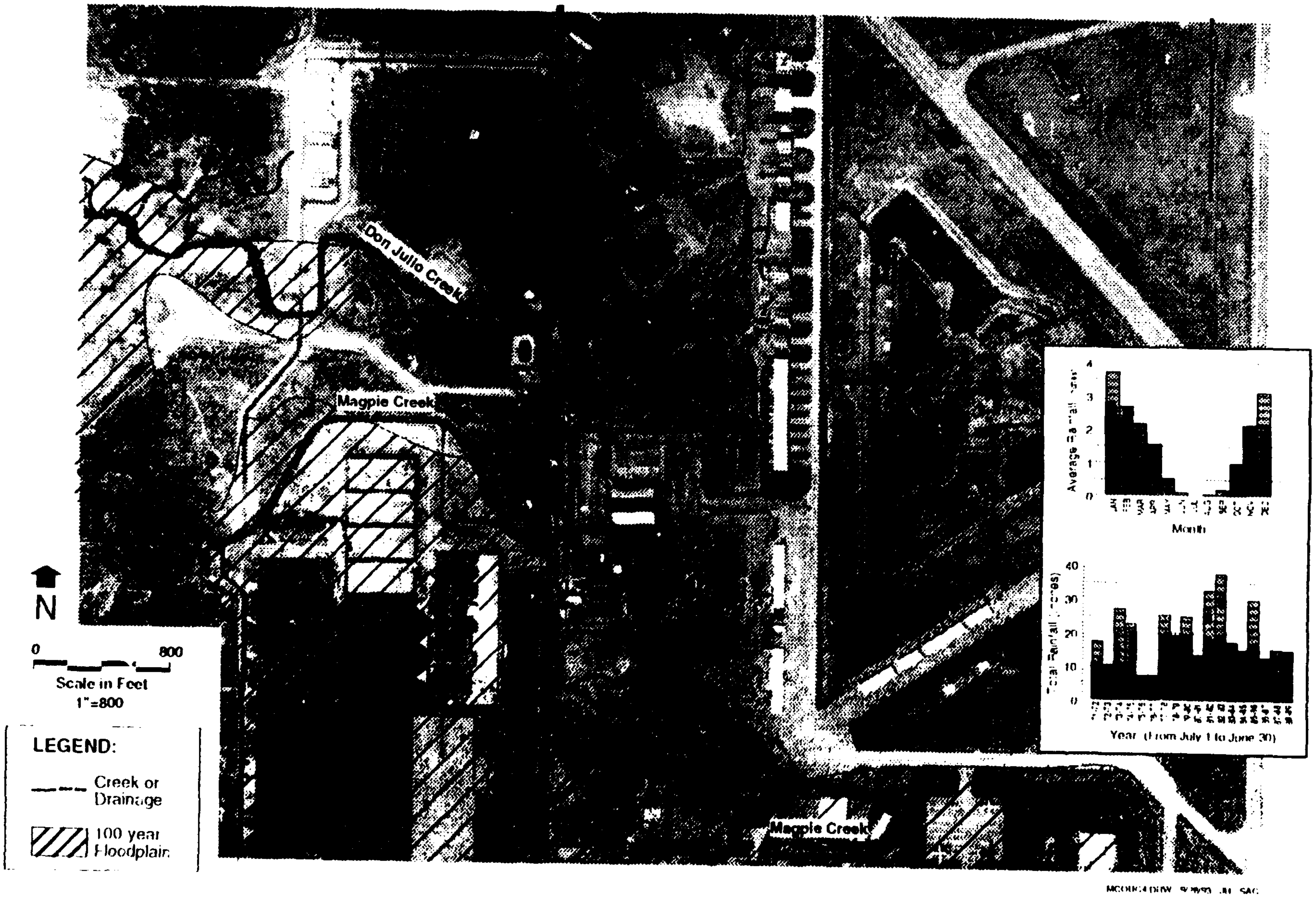

Figure 2-4. Drainages and 100-year Floodplain in Operable Unit C

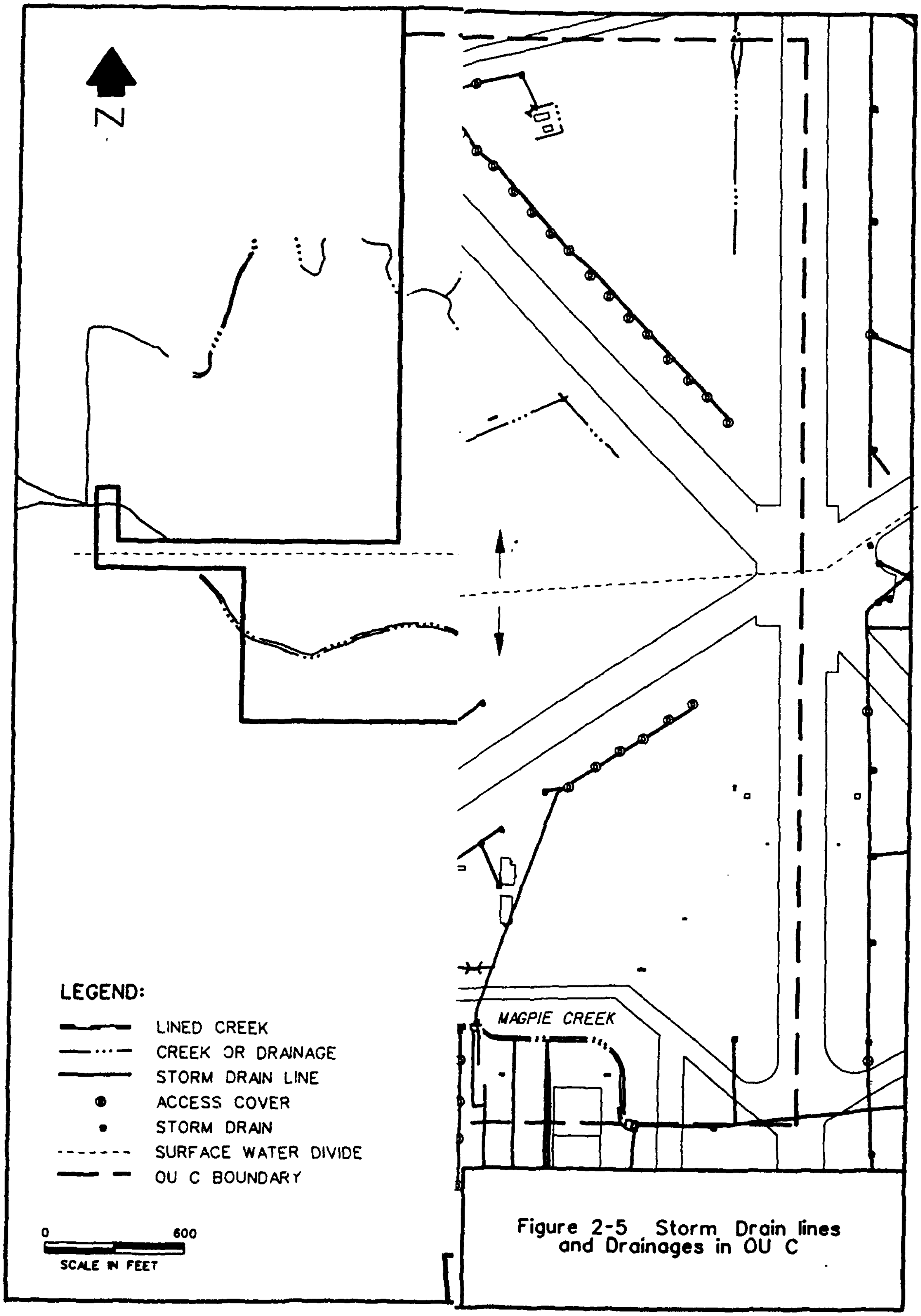

Figure 2-5 Storm Drain lines and Drainages in OU C

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2.1.3 Surface Soil

Soil types in the vicinity of McClellan AFB are extremely variable. The surface soils (less than 5 feet deep) have formed from mixed alluvium derived from stream erosion of granitic rocks in the Sierra Nevada. A silica-cemented hardpan, approximately 2 to 4 inches thick, has developed over large areas at 3 to 10 feet below the ground surface. Surface textures are predominately loams and sandy loams which are underlain by finer-textured loam and sandy clay loam horizons above the hardpan (U.S. Department of Agriculture, 1990).

Soil permeabilities in the vicinity of OU C range from 0.6 inch to 2.0 inches per hour, depending on local amounts of clay and hardpan. The local soils are generally classified as Durixeralfs, San Joaquin fine sandy loam, Fiddyment fine sandy loam, or San Joaquin Xeralfic-Arents complex. These soils have a low shrink-swell potential, a slight erosion potential, and a very low water capacity of approximately 0.10 to 0.14 inch per inch. Soil classifications mapped in OU C by the U.S. Department of Agriculture (1990) are shown in Overlay A to Figure 2-6.

McClellan AFB surface soils have also been classified by land use type (McClellan AFB, 1993b) for a basewide background study of naturally and anthropogenically occurring concentrations of inorganic and organic constituents in surface soil and stream sediments. Four common, but widely separated environments, or landscapes, were identified in the study:

- Landscape I: Lawns and soil areas associated with on-base and off-base residences;
- Landscape II: Apparently native soil associated with high areas around vernal pools;
- Landscape III: Open grasslands that may have been graded and otherwise disturbed; and
- Landscape IV: Sparsely grassed, open ground.

The surface soil types in OU C are Landscape II, III, and IV (Overlay B to Figure 2-6).

The surface soil background study is not yet complete; however, results may indicate that surface soil in each land use category has a different background value for natural and anthropogenic constituents. The background values will be used to help determine if concentrations detected in surface soil and stream sediment require remediation.

2.1.4 Ecological Resources

Operable Unit C contains several habitat types. The native vegetation in this region is grassland prairie containing localized areas of riparian woodlands and vernal pools. Native vegetation presently occurs in the northwest portion of OU C. Although parts of this area were previously used for agriculture, it currently contains the greatest diversity of plants and animals at McClellan AFB. The eastern one-third of OU C is dominated by paved runways and non-native, disturbed grasslands and non-native plant species. The central and southwestern portions of OU C contain primarily developed land with patches of non-native, disturbed grasslands and several man-made aquatic habitats.

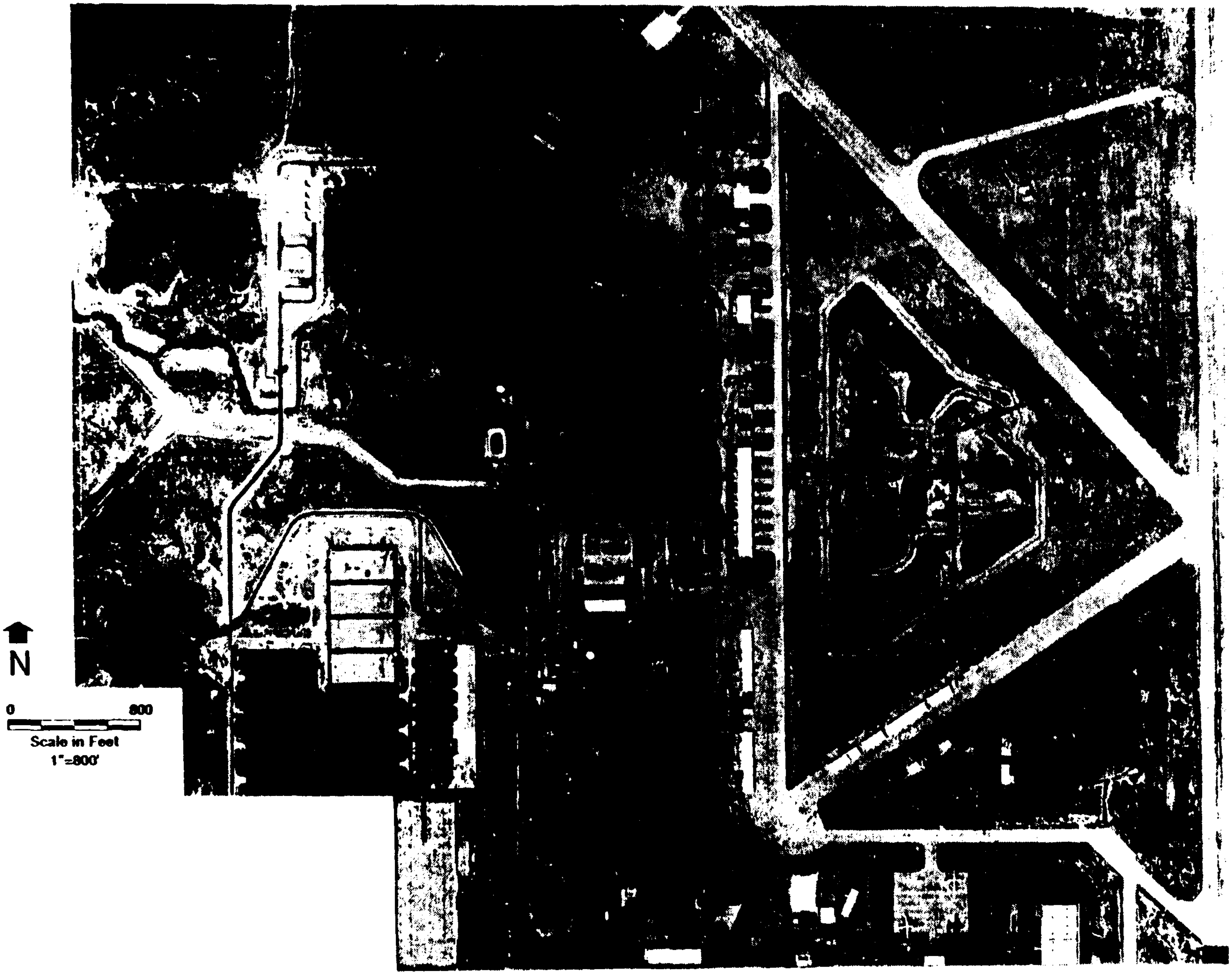
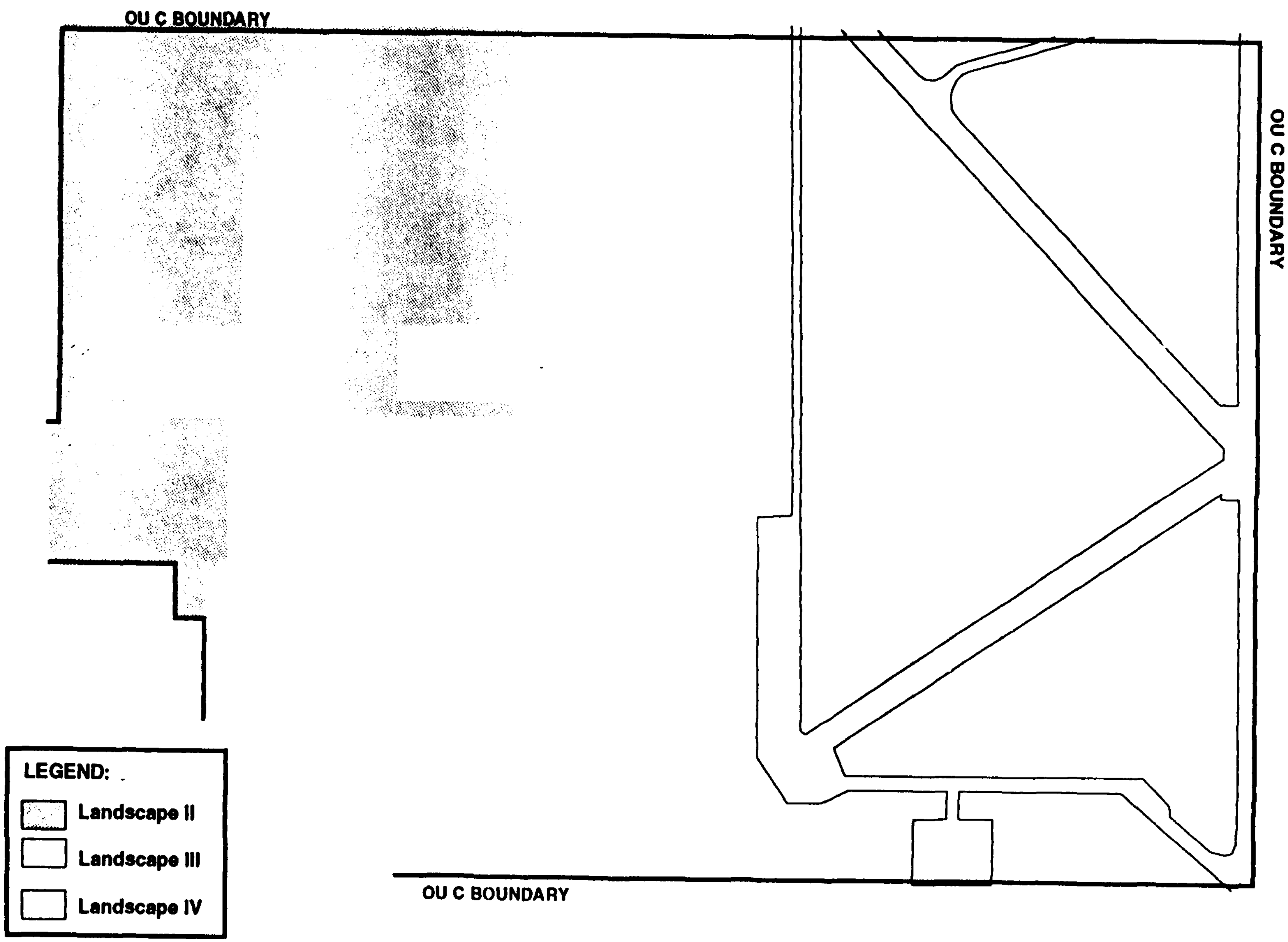
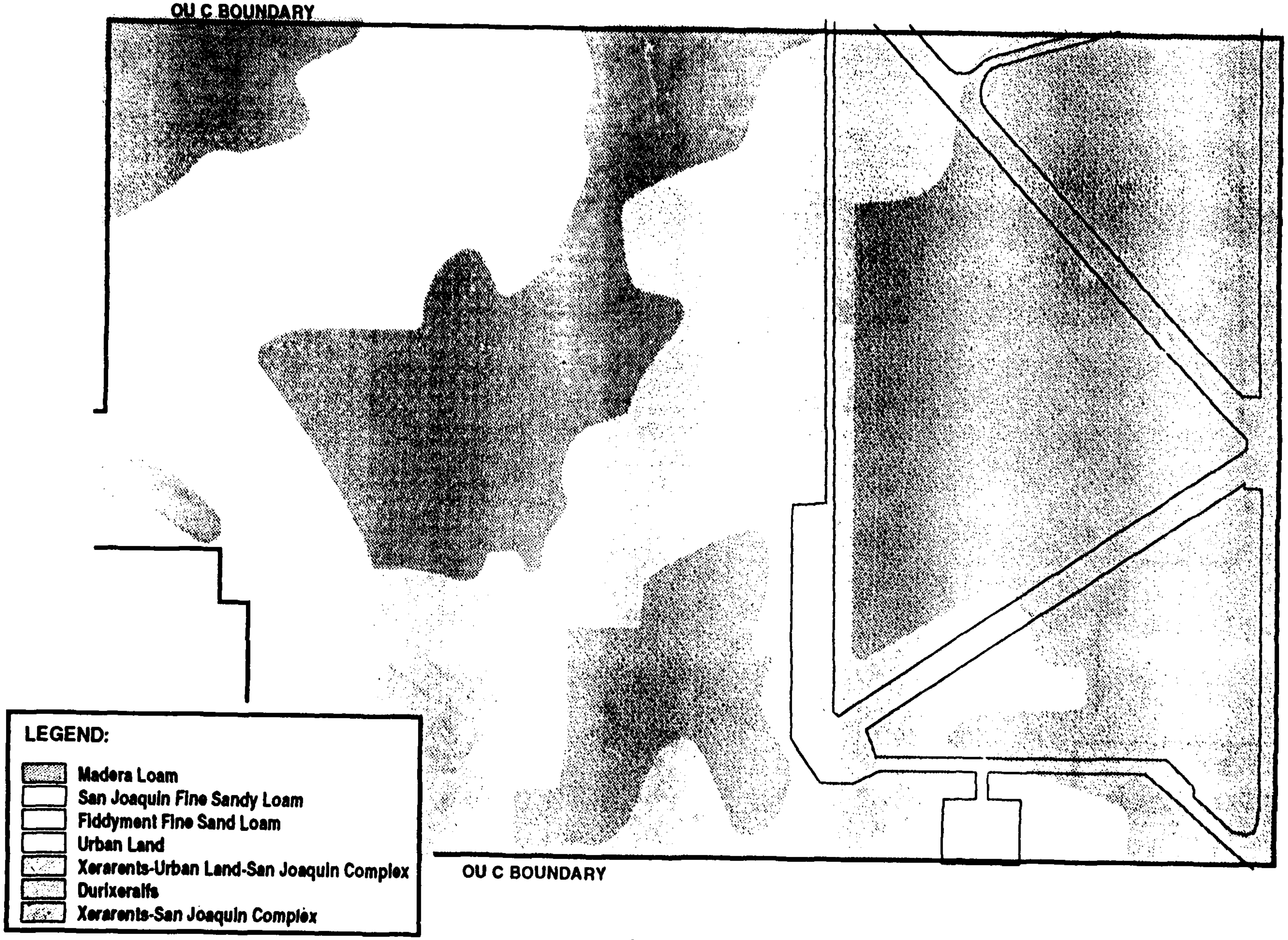


Figure 2-6. Aerial Photograph of Operable Unit C



Overlay to Figure 2-6. Extent of Landscapes in Operable Unit C



Overlay to Figure 2-6. Extent of Soil Types in Operable Unit C

Biological field surveys in OU C (CDFG, 1987 and U.S. EPA, 1992) indicate that although no endangered, threatened, rare or candidate species were reported, the area contains significant ecological resources. Over 50 mammalian and avian species and 110 plant species were reported in OU C during the surveys.

Most of Don Julio and Magpie creeks east of Patrol Road are channelized and contain no significant habitats. West of Patrol Road, the creeks support an intermittent narrow corridor of riparian and freshwater aquatic habitats. The upland areas adjacent to the creek are grasslands containing vernal pools ranging in diameter from 10 to 150 feet. Man-made ponds in OU C are used for resting and foraging by several species of waterfowl.

2.2 Subsurface Features

The subsurface of OU C consists of approximately 95 feet of vadose zone, from surface to the water table, and approximately 1,000 feet of saturated (groundwater) zone underlain by nonwaterbearing bedrock (Radian, 1992b). Results of previous investigations (McLaren, 1986; EG&G Idaho, 1988; Radian, 1988; Radian, 1992b) provide the greatest amount of information about the vadose zone and groundwater to a depth of 450 feet below ground surface (BGS). The vadose zone and shallow groundwater zone (100 to 450 feet BGS) comprise the subsurface environment most likely to have been affected by contaminants; therefore, subsurface features of these zones are the focus of this section.

From the surface of OU C to a depth of 450 feet BGS, the subsurface consists of alluvial and fluvial deposits of sediment eroded from the Sierra Nevada that were deposited over approximately the last 5 million years. Uplift of the Sierra Nevada (3 to 5 million years ago) and changing climatic conditions, including mountain glaciation (2 to 0.1 million years ago), resulted in deposition of sediments in alluvial fan and alluvial plain environments by streams flowing toward the west or southwest from higher elevations. These streams, fed by rains and melting glaciers, alternately deposited, eroded, and redeposited sediments along frequently changing courses. Streams flowing down alluvial fans carried gravel, sand, silt, and clay sediment particles through braided and mobile channel belts (Figure 2-7). When streams overflowed their channels during floods, silt, clay, and fine sand were carried out of the stream channel and were deposited on the floodplain. Most of the coarse sand and gravel remained within the channels and were deposited when the streams had too little energy to transport them downstream. Finer particles of silt and clay particles suspended in the streams were carried further downstream to lower-lying floodplains or standing water bodies (i.e., a lake or the ocean) before being deposited. Braided and mobile channel belts tended to migrate laterally with time. This migration affected not only the location and thickness of the coarsest sands or gravels, but the location and thickness of silt and clay deposits adjacent to the stream channels.

Figure 2-7 schematically represents the surface relationship between braided and mobile channel belts in the transition from an alluvial fan to an alluvial plain and subsurface relationships that could result from lateral migration of channels through time. It is evident that deposits consisting of one lithologic type are limited in horizontal and vertical extent. Coarse deposits in the buried channels may grade laterally or vertically into fine deposits, and fine deposits may grade into coarser deposits over relatively short distances

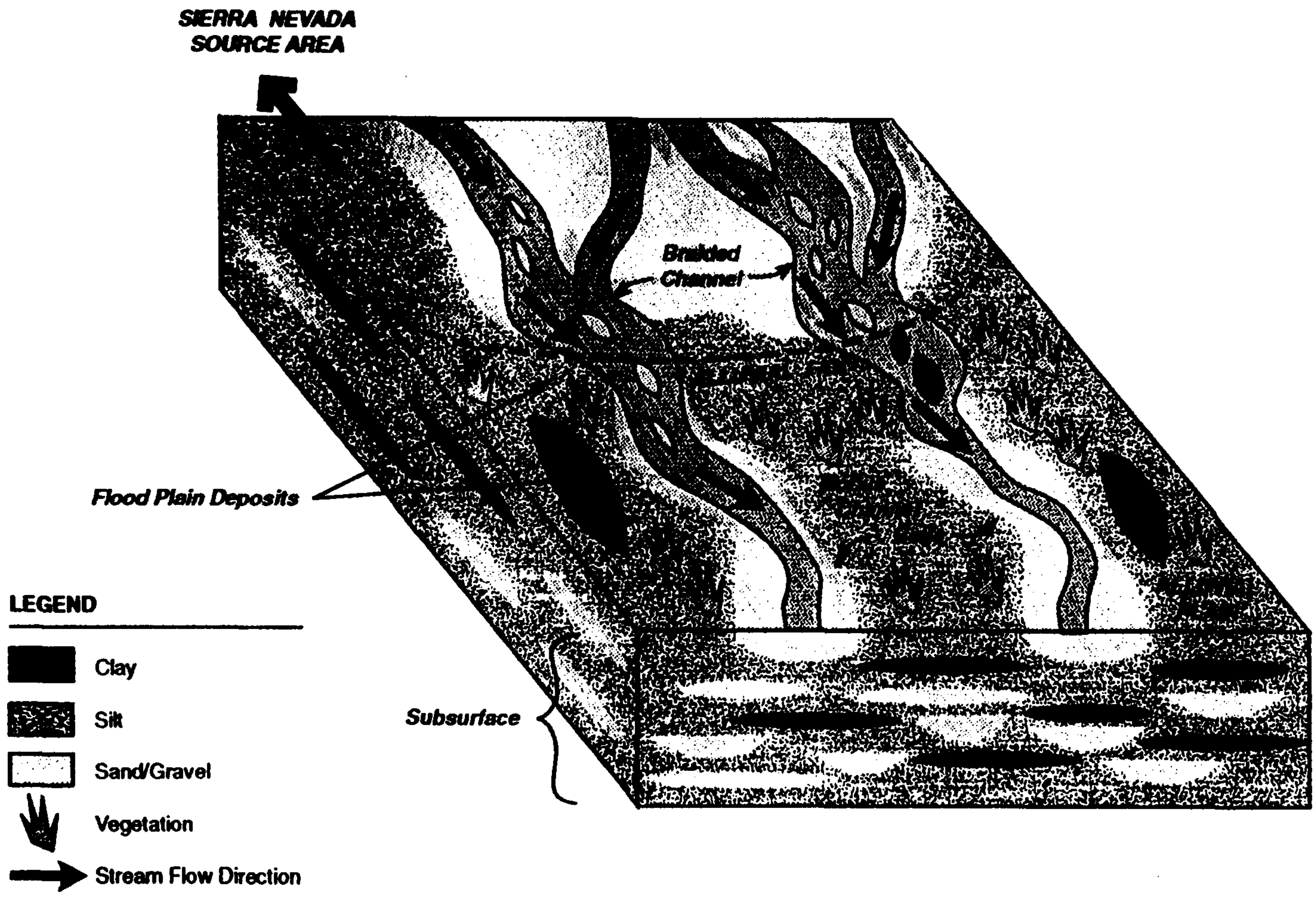


Figure 2-7. Schematic Diagram of Alluvial Fan/Alluvial Plain Deposition through Time in OU C

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25 feet or less). In the subsurface of OU C, the lateral and vertical variation in subsurface deposits results in heterogeneity in grain size, porosity, and permeability over short distances. Porosity and permeability control the migration of water and soil gas through the subsurface. Because subsurface heterogeneity and complexity are similar to that illustrated in Figure 2-7, the migration of water and soil gas beneath OU C is affected by variations in porosity and permeability.

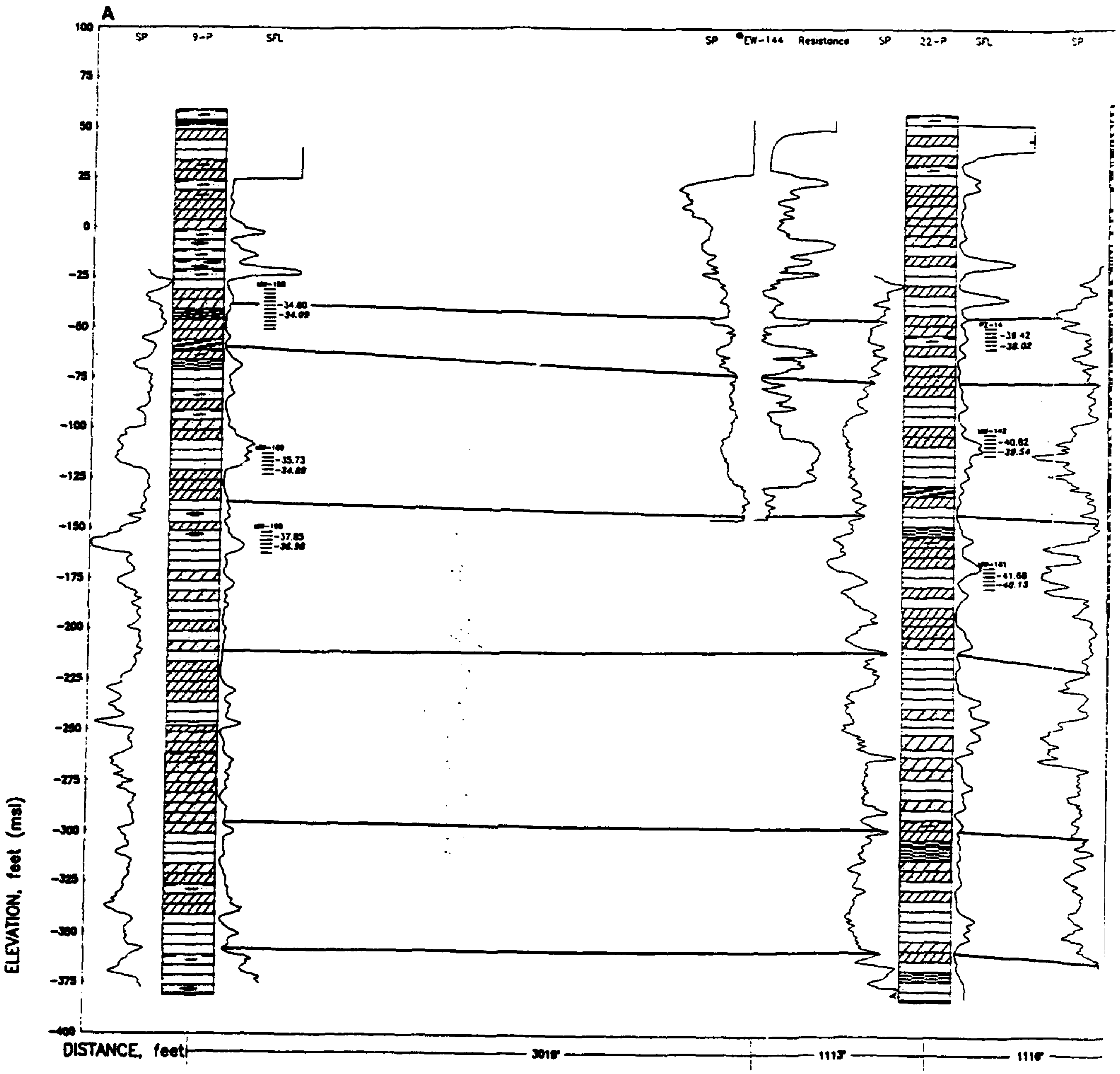
A north-south cross section was constructed from lithologic and geophysical measurements from pilot hole borings in OU C and OU B, south of OU C (Figure 2-8). In the figure, five groundwater monitoring zones are identified. The monitoring zones are a means of organizing the data collected for the groundwater by depth. The heterogeneity of the sediments and the water quality in the zones indicate no consistent aquitards exist that would affect contaminant migration. Supporting rationale and methodology for determination of groundwater monitoring zone boundaries are presented in the PGOURI Technical Report (Radian, 1992b). The borings are located a minimum of 1,113 feet apart; therefore, the cross section should be used only to evaluate broad trends in subsurface geology.

2.2.1 Vadose Zone

Lithologic descriptions are available from approximately 400 borings drilled into or through the vadose zone of OU C for site characterization or installation of monitoring or extraction wells. The descriptions provide additional evidence of the heterogeneous nature of the deposits in the vadose zone. Gravel, coarse sand, and pure clay deposits are rare or not present. Poorly sorted sands containing 5–20% silt or clay particles and silts containing 5–20% sand or clay particles are the most frequent lithologies encountered in borings. Moderate to well-indurated silt layers have been penetrated at various depths in OU C; however, only the hardpan layer encountered between 3 and 10 feet BGS is areally extensive.

As a result of the heterogeneous nature of the vadose zone of OU C, permeabilities would be expected to increase or decrease significantly where two different lithologies are in contact. *However, the poorly sorted condition of most of the layers and the presence of plant root bores have a modifying effect on the permeability and other physical parameters.* Results of permeability testing in OU C1 and other OUs show that primary permeability is decreased in the sand layers by the presence of silt and clay particles and is increased in silts by the presence of sand particles. *These modifications in permeability decrease the differences between vadose zone deposits, causing them to behave as a somewhat isotropic system.* Relatively high and low permeabilities exist, however, in well-sorted sands and in clays and clayey silts, respectively.

Because of the importance of permeability in controlling the rate of water percolation and soil gas migration, the vadose zone of OU C has been characterized by estimated permeabilities rather than lithologic descriptions. "High" (sands and gravels), "medium" (sandy clay, sandy silt, silty sand, and silty gravel), and "low" (clays and silts) designations were selected for permeability ranges that have been measured in soil types similar to OU C soils described in hydrogeologic literature. The estimated permeability designations were assigned to OU C soils that had descriptions matching the literature descriptions.



SOURCE: PGOURI Technical Report (Radian, 1992)

1)

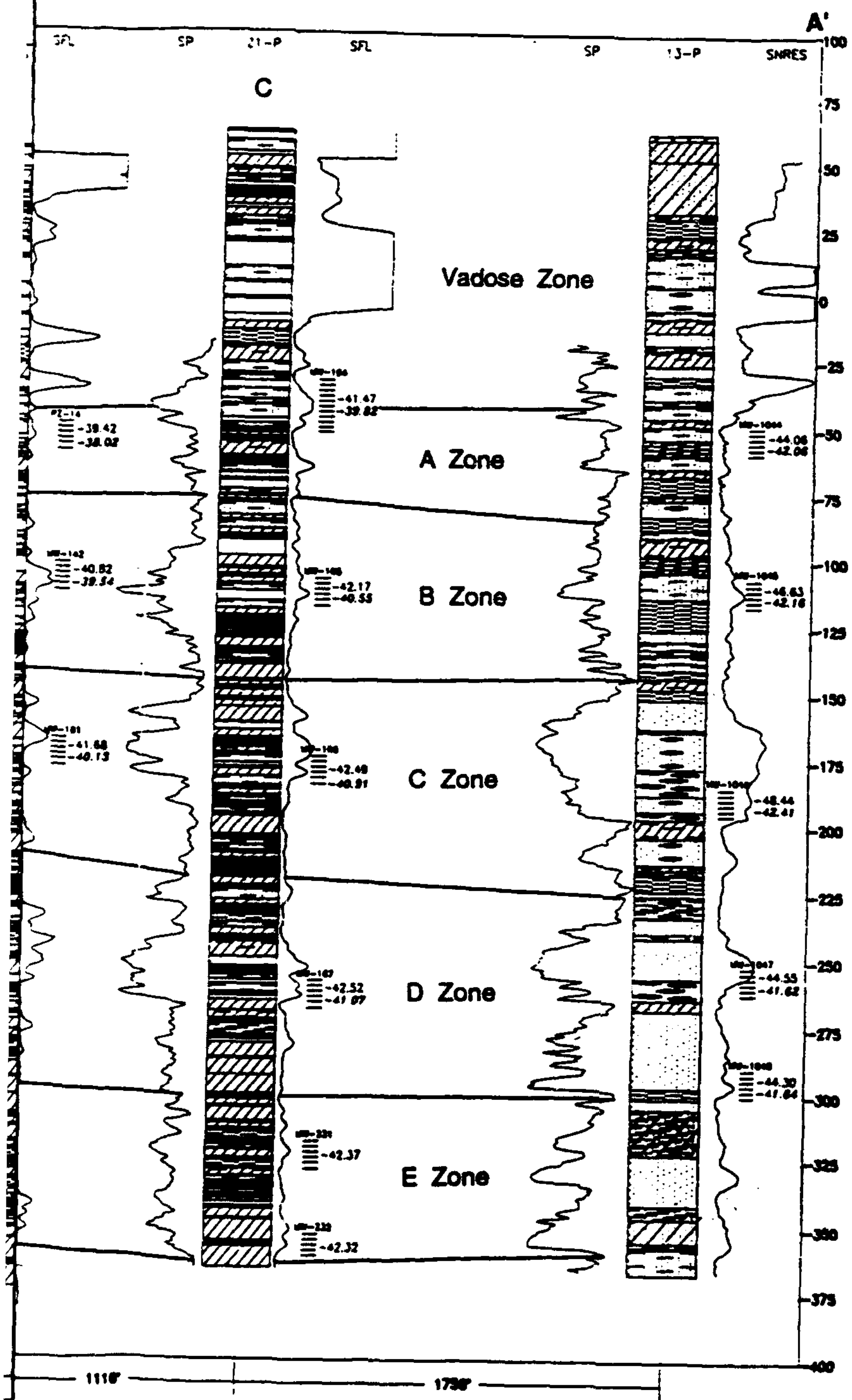


Figure 2-8.
Geologic Cross Section A - A'
Including Geophysical Logs and
Groundwater Monitoring Zones

LEGEND

- No Recovery
- Asphalt
- Fill
- Clay
- Gravelly Clay
- Silty Clay
- Sandy Silty Clay
- Sandy Clay
- Silty Sandy Clay
- Gravel
- Clayey Gravel
- Silty Gravel
- Sandy Gravel
- Silt
- Clayey Silt
- Sandy Clayey Silt
- Gravelly Silt
- Sandy Silt
- Clayey Sandy Silt
- Sand
- Clayey Sand
- Silty Clayey Sand
- Gravelly Sand
- Silty Sand
- Clayey Silty Sand

SP = Spontaneous Potential Log

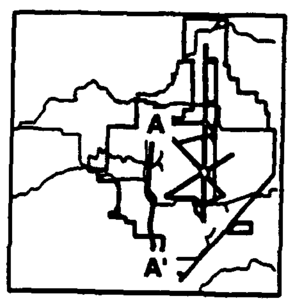
SFL = Spherically Focused Log (Range = 0:200 OHMM)

SNRES = Short Normal Resistivity Log (Range = 0:200 OHMM)

C = Continuous Core

*Lithology for EW-144 was not recorded during drilling. Cuttings were not retained for geologic analysis.

MW-000—Monitor Well Number
—30.00 Fourth quarter 1990 water elevations
—00.00 Third quarter 1990 water elevations
—Screen



GENERATED BY: Vivian M Gaddie	DATE: 9-17-93
REVIEWED BY: Thomas F. Cudzilo	DATE: 9-30-93
APPROVED BY: Vick F. Auwhar	DATE: 9-30-93

(2)

Two cross sections (Figure 2-9 and 2-10) illustrate the variations in the OU C vadose zone on the basis of estimated permeabilities. Cross section B-B′ is a north-south cut through the vadose zone beneath Investigation Cluster (IC) 20 in the north-eastern part of OU C (Figure 2-9). In this figure, soil types were combined based on estimated permeability. Permeabilities of lithologic groups are represented by different colors. The depositional history remains identifiable even with the combination of lithologies into permeability groups. The lenticular shape of deposits in a mobile channel/flood plain environment is evident beneath IC 20, even though the borings are 175 to 425 feet apart and uniform sand layers may not be more than 50 feet wide. Cross section C-C′ illustrates similar depositional history and permeability relationships in the vadose zone beneath IC 12, some 2,200 feet south of cross section B-B′.

Black sand deposits and perched water are additional features of the vadose zone identified locally within OU C1, but which may be found more widely distributed during the OU C remedial investigation (RI). Each feature could affect the assessment of an IC if it were present in the subsurface.

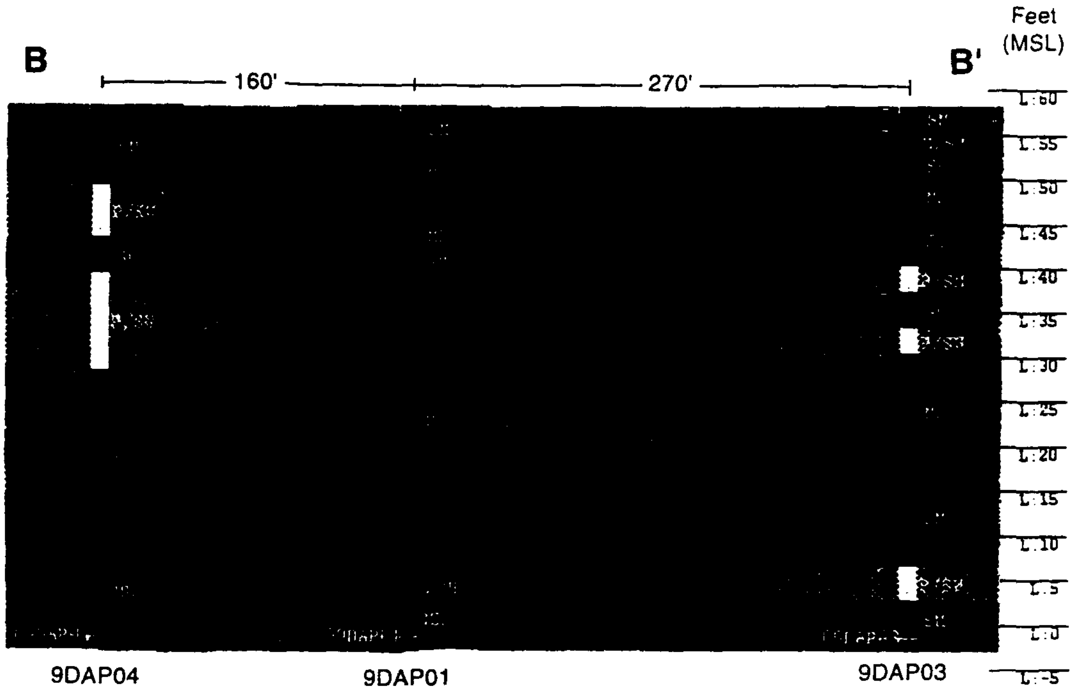
Black sand grains comprise 15–20% of the sand layers in the depth interval 45–80 feet BGS and as much as 25% in the interval from 63–69 feet BGS beneath OU C1 (Jacobs, 1992b). Both above and below these depth intervals black sand content decreased to a trace (< 10%). *The black sands are important to the RI in OU C because the increase in black sand grains may coincide with an increase in naturally occurring concentrations of arsenic in soil* (Jacobs, 1992b).

Perched water was encountered at depths of 10–20 feet BGS in some borings drilled in OU C1 (Jacobs, 1992). Perched water is groundwater encountered in subsurface drilling that is separated from the true saturated zone by an interval of unsaturated deposits. Because the saturated zone occurs 80–90 feet deeper, groundwater at 10–20 feet BGS is perched. The perched water was not consistently encountered throughout OU C1 and could not be correlated to an underlying low permeability layer that impeded vertical migration. *The occurrences of perched water may be related to the location of subsurface water discharge points (e.g., leaking water impoundments or leaks in the Industrial Wastewater Line [IWL]).*

Another feature of the vadose zone beneath McClellan AFB that will be present in OU C is the contaminant "smear zone." Smear zones are depth intervals of vadose zone deposits that contain a residue of contaminants from contaminated groundwater that had been migrating through the pores between soil grains. The contaminant residues remain as liquid films on grains, solid adsorbed precipitates, or gases in pore spaces as groundwater levels recede and soil gas fills the pore space previously saturated with water. *It is essential to identify smear-zone contamination during the RI because it may require remedial action and it may also lead to a false assumption that contaminants migrated vertically from an area with no other evidence of contaminant discharge.*

2.2.2 Groundwater Zone

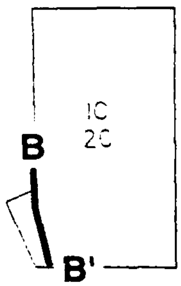
The upper surface of groundwater occurs at approximately 100 feet BGS beneath OU C and slopes from north to south. This upper surface can be considered the boundary between the vadose zone and the A ground-



KEY

High Permeability	Moderate Permeability	Low Permeability
GC = Clayey Gravel	SM = Silty Sand	ML = Sandy Clayey Silt
GM = Silty Gravel	SC = Clayey Sand	MH = Elastic Silt
GP = Sandy Gravel		CL = Sandy Silty Clay
GW = Gravelly Sand		CH = High Plasticity Clay
SW = Well Graded Sand		
SP = Poorly Graded Sand		

LOCATION MAP



NOTE: Distances represent actual distances between borings. To generate cross section, borings were projected on a line transecting the location.

SOURCE: McLaren 1986b

Figure 2-9. Cross Section B - B' Lithologic Units and Inferred Permeabilities, Vadose Zone, IC 20, OU C

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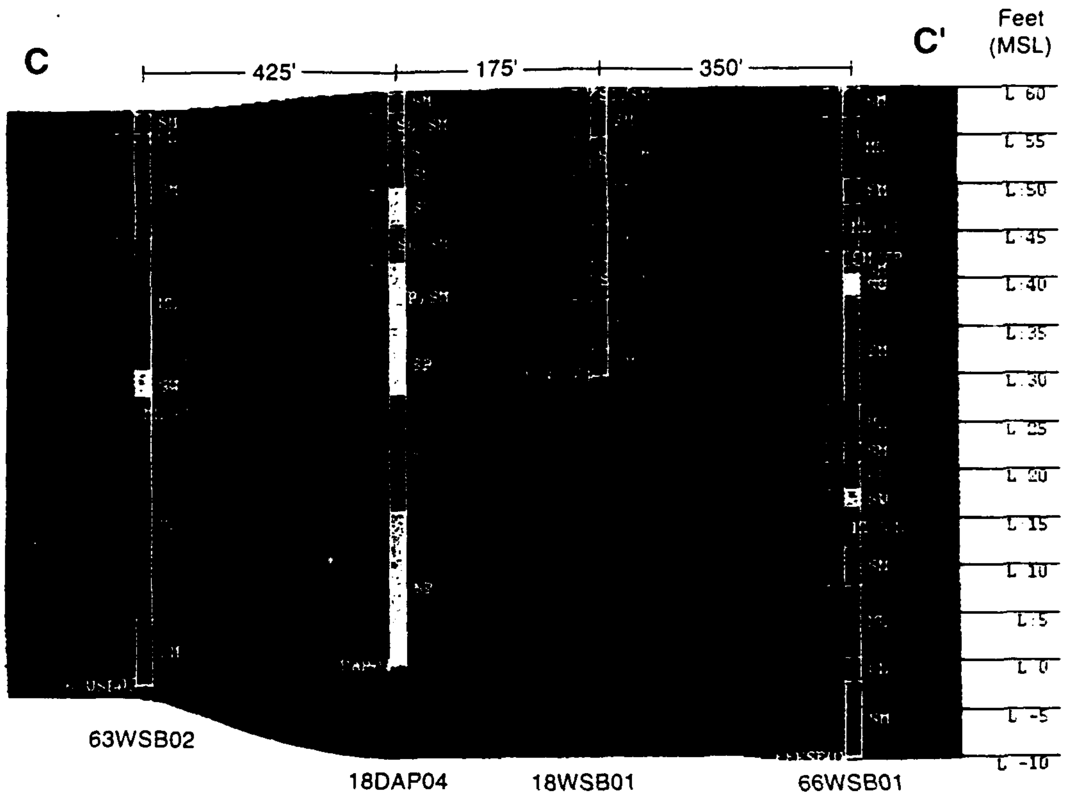

KEY

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SW = Well Graded Sand		
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NOTE: Distances represent actual distances between borings. To generate cross section, borings were projected on a line transecting the location.

SOURCE: McLaren 1986b

LOCATION MAP

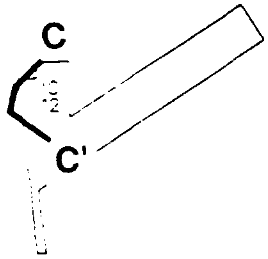

Figure 2-10. Cross Section C - C' Lithologic Units and Inferred Permeabilities, Vadose Zone, IC 12, OU C

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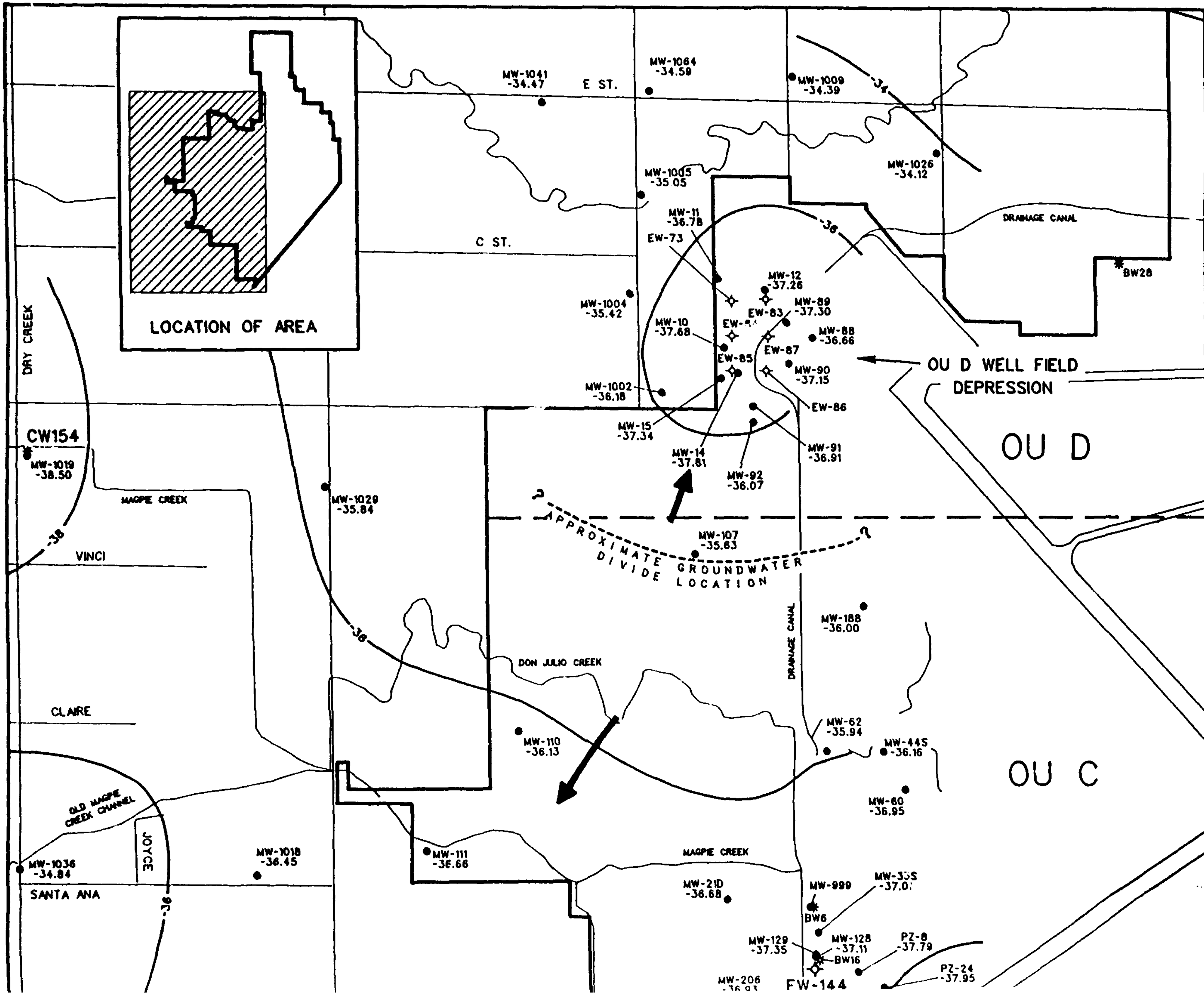
water monitoring zone, shown in cross section A-A' (Figure 2-8), although the saturated portion of the capillary fringe extends at least a few feet above the groundwater surface. Groundwater in the complex aquifer to a depth of 450 feet beneath OU C has been divided into six monitoring zones, designated A through F. The monitoring zones are a method of organizing groundwater data collected by depth. The zones were determined from the location of semi-continuous fine-grained layers, water level differences, and contaminant distributions. The A zone is unconfined. Deeper monitoring zones have locally shown characteristics of leaky confined aquifer behavior (Radian, 1992b). There is evidence of hydraulic communication between the A and B, B and C, C and D, and D and E monitoring zones in OU C.

In April 1993, the A zone groundwater surface sloped from an elevation of -36 feet MSL to approximately -40 MSL between monitoring wells near the northern and southern boundaries of OU C (Figure 2-11). The horizontal flow direction in the A through D zones is south to southeast (for B and C zones, see Figures 2-12 and 2-13). There are not enough monitoring wells completed in the E Zone and none completed in the F zone to determine if their flow directions are approximately the same as in the A through D zones; however, flow directions in the deeper zones are likely to be similar because of regional hydraulic gradients.

The groundwater flow directions beneath OU C and most of McClellan AFB are strongly influenced by the regional gradients produced by a groundwater depression centered on a location less than a mile south of the McClellan AFB boundary (Figure 2-14). The depression is the result of groundwater withdrawals from municipal supply wells. Base Water Supply Well (BW) 18, located in OU B, contributes to the regional groundwater depression and has hydraulic effects within OU C as a result of the local gradient it produces in the A through E monitoring zones (Figures 2-11, 2-12, and 2-13).

Regional groundwater flow directions have varied from westerly to northerly to southerly, and groundwater elevations have decreased within the last eighty years as the Sacramento area has developed (Figure 2-15). In the fall of 1955, the groundwater surface elevation beneath OU C was approximately 15 feet above MSL, or 45 to 55 feet BGS. Groundwater levels have decreased at an average rate of more than 1.25 feet per year as a result of overdrafting the aquifer. Therefore, any contaminants that were released near the surface of OU C in the 1940s and 1950s had to migrate approximately half the distance vertically to reach groundwater than would contaminants released in 1993. After reaching groundwater, any dissolved contaminants may have migrated laterally to the west, north, or south as horizontal gradients changed and migrated vertically through 50 feet of aquifer that was consistently drawn down. *The lateral and vertical migration has probably led to development of widespread contaminant smear zones in the lower vadose zone beneath OU C.*

Groundwater flow directions in OU C are also affected locally by groundwater withdrawals (i.e., extraction well fields in OU D and OU C and an off-base municipal well). Six wells were constructed and began extracting contaminated groundwater in OU D in 1987. The wells produce a depression in the groundwater levels of the A and B monitoring zones evident approximately 1,100 feet north of the OU C boundary (Figures 2-11 and 2-12). The groundwater contours for the A monitoring zone suggest that the hydraulic



LOCATION OF AREA
OU D WELL FIELD
DEPRESSION
OU D
OU C
APPROXIMATE GROUNDWATER DIVIDE LOCATION
E ST.
C ST.
DRAINAGE CANAL
DRY CREEK
MAGPIE CREEK
DON JULIO CREEK
OLD MAGPIE CREEK CHANNEL
VINCI
CLAIRE
JOYCE
SANTA ANA
CW154
MW-1019
-38.50
MW-1041
-34.47
MW-1064
-34.59
MW-1009
-34.39
MW-1026
-34.12
BW28
MW-1005
-35.05
MW-11
-36.78
EW-73
MW-1004
-35.42
MW-10
-37.68
MW-12
-37.26
EW-83
MW-89
-37.30
MW-88
-36.66
EW-87
MW-90
-37.15
EW-85
EW-86
MW-1002
-36.18
MW-15
-37.34
MW-14
-37.81
MW-92
-36.07
MW-91
-36.91
MW-1029
-35.84
MW-107
-35.63
MW-188
-36.00
MW-110
-36.13
MW-62
-35.94
MW-44S
-36.16
MW-60
-36.95
MW-111
-36.66
MW-1018
-36.45
MW-1036
-34.84
MW-21D
-36.68
MW-999
BW6
MW-129
-37.35
MW-128
-37.11
BW16
PZ-8
-37.79
PZ-24
-37.95
MW-206
FW-144
-34
-36

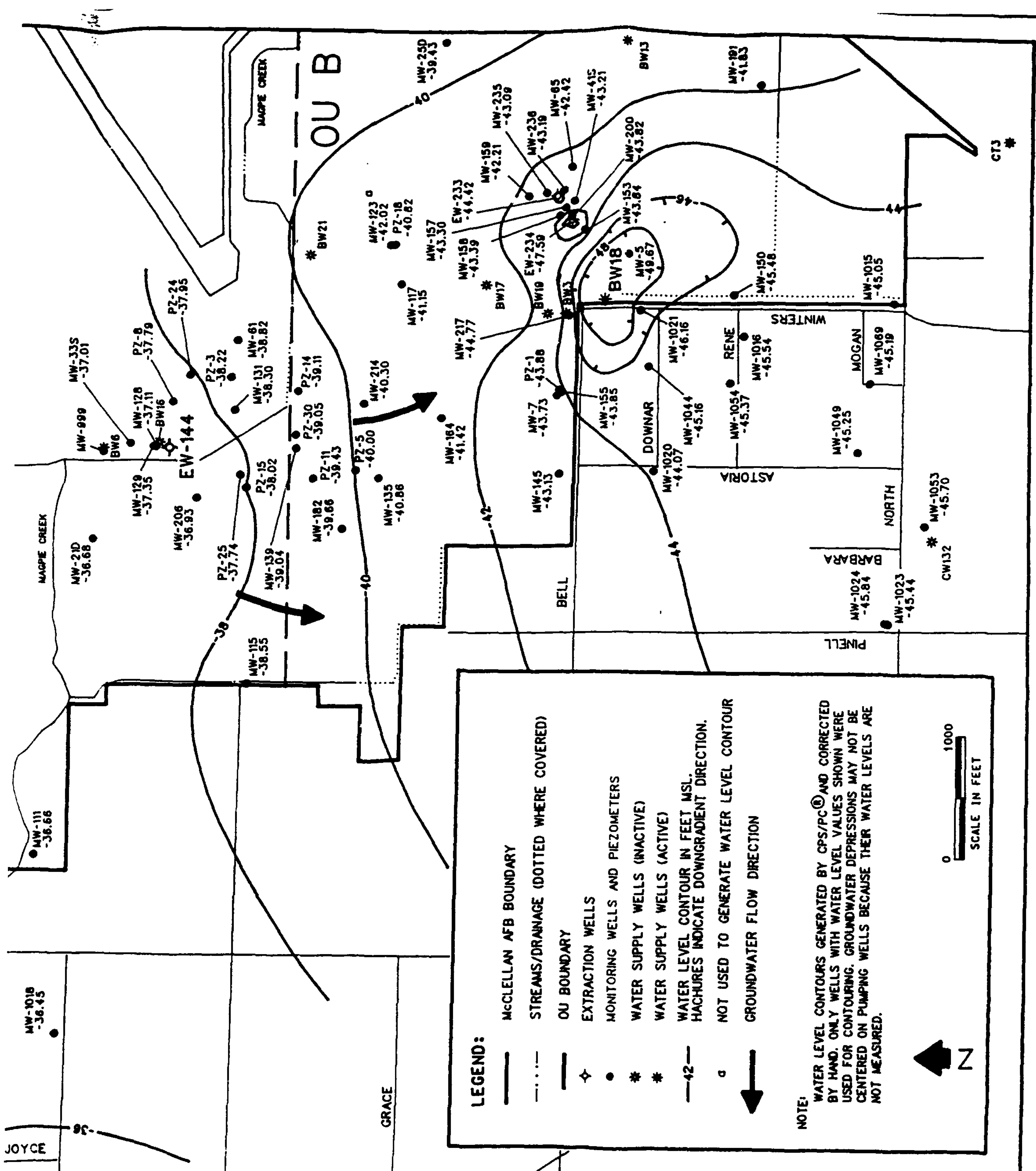


Figure 2-11 Well Locations and Groundwater Contours in the A Monitoring Zone, April 1993

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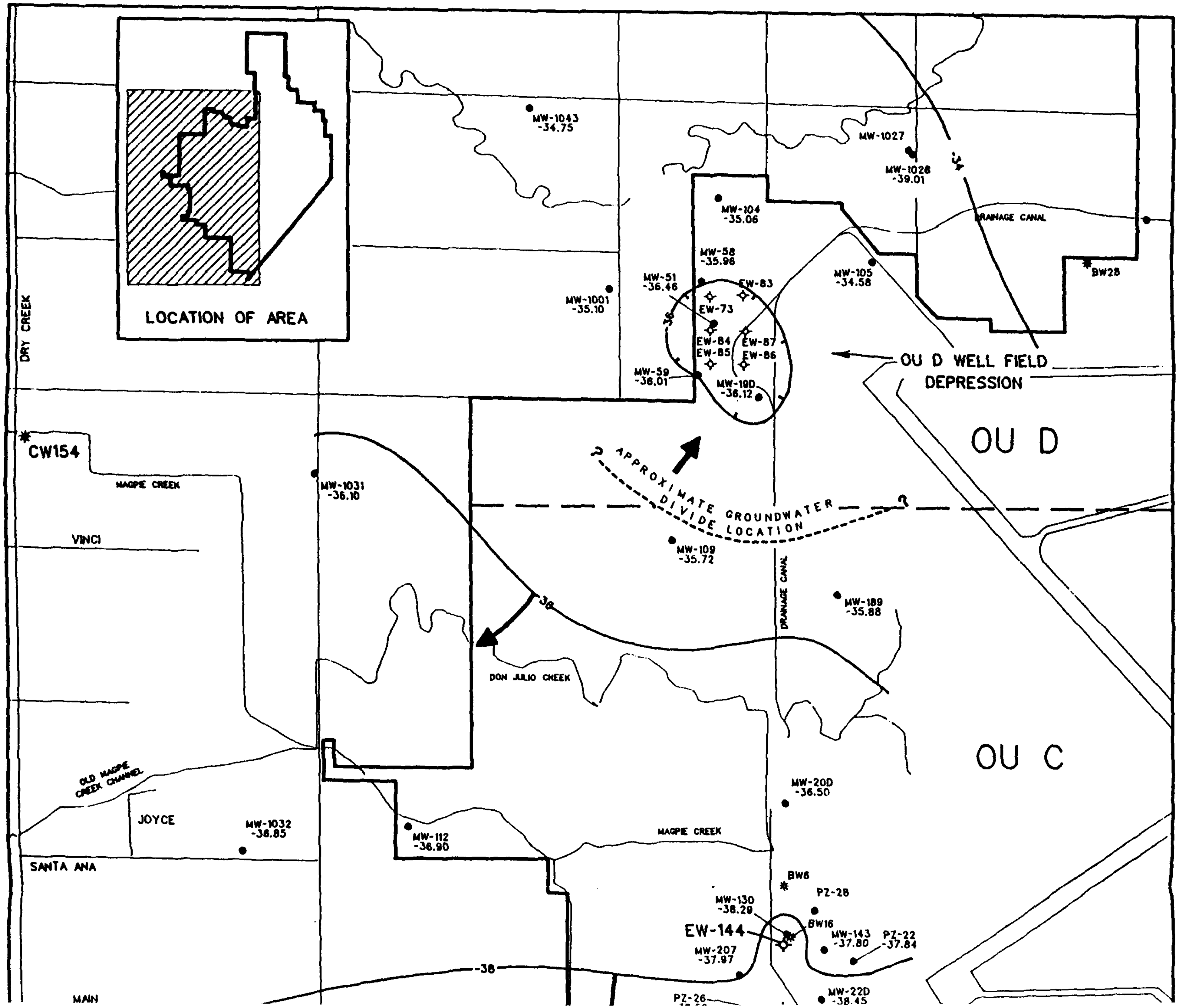

LOCATION OF AREA
OU D WELL FIELD DEPRESSION
OU D
OU C
APPROXIMATE GROUNDWATER DIVIDE LOCATION
DRY CREEK
CW154
MAGPIE CREEK
VINCI
OLD MAGPIE CREEK CHANNEL
JOYCE
SANTA ANA
MAIN
DON JULIO CREEK
DRAINAGE CANAL
MW-1043 -34.75
MW-1001 -35.10
MW-1027
MW-1028 -39.01
MW-104 -35.06
MW-58 -35.96
MW-51 -36.46
MW-59 -36.01
MW-190 -36.12
MW-105 -34.58
BW28
EW-83
EW-73
EW-84
EW-85
EW-87
EW-86
MW-1031 -36.10
MW-109 -35.72
MW-189 -35.88
MW-20D -36.50
MW-1032 -36.85
MW-112 -36.90
BW6
PZ-28
MW-130 -38.29
BW16
EW-144
MW-143 -37.80
PZ-22 -37.84
MW-207 -37.97
MW-22D -38.45
PZ-26
-34
-36
-38

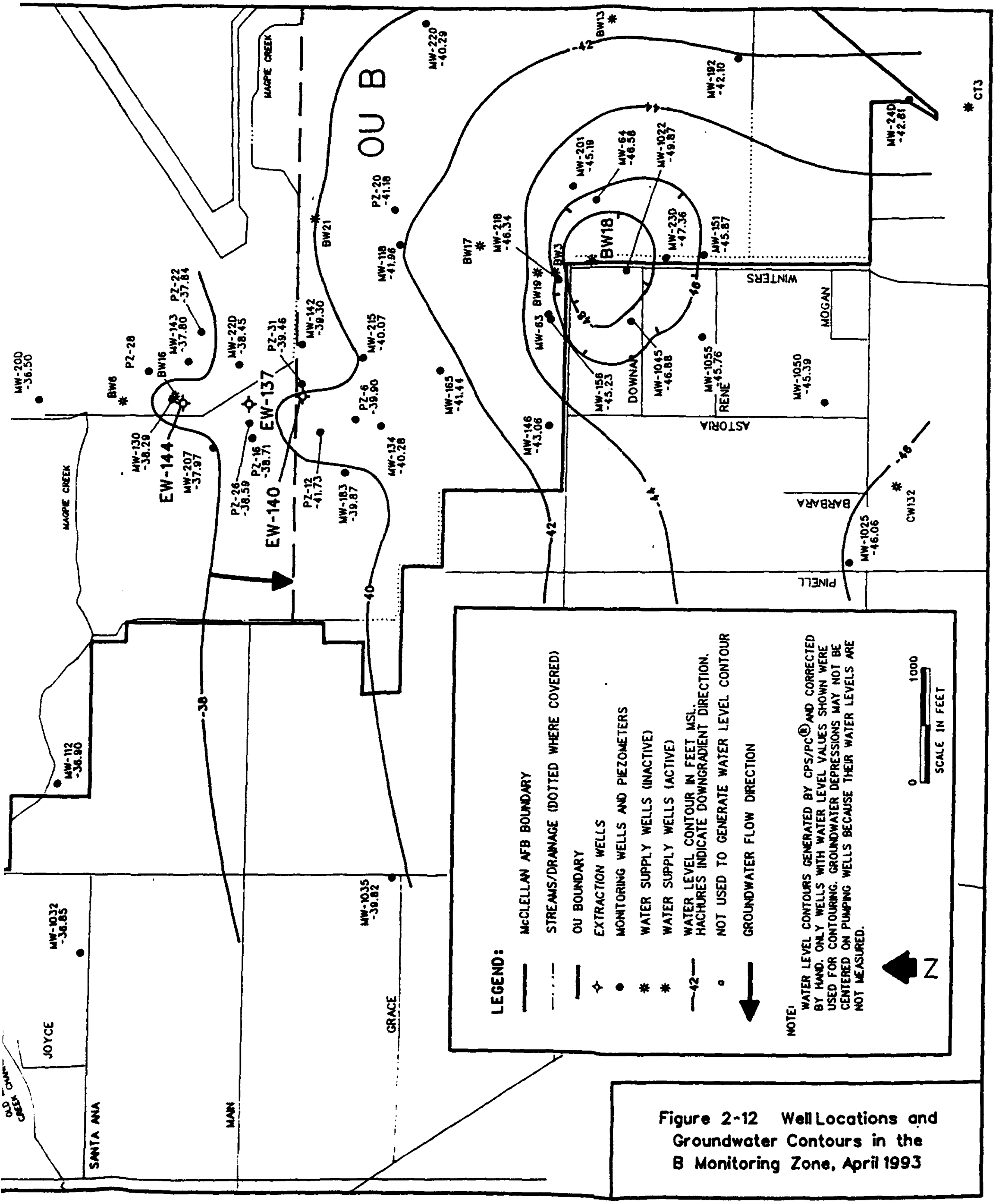
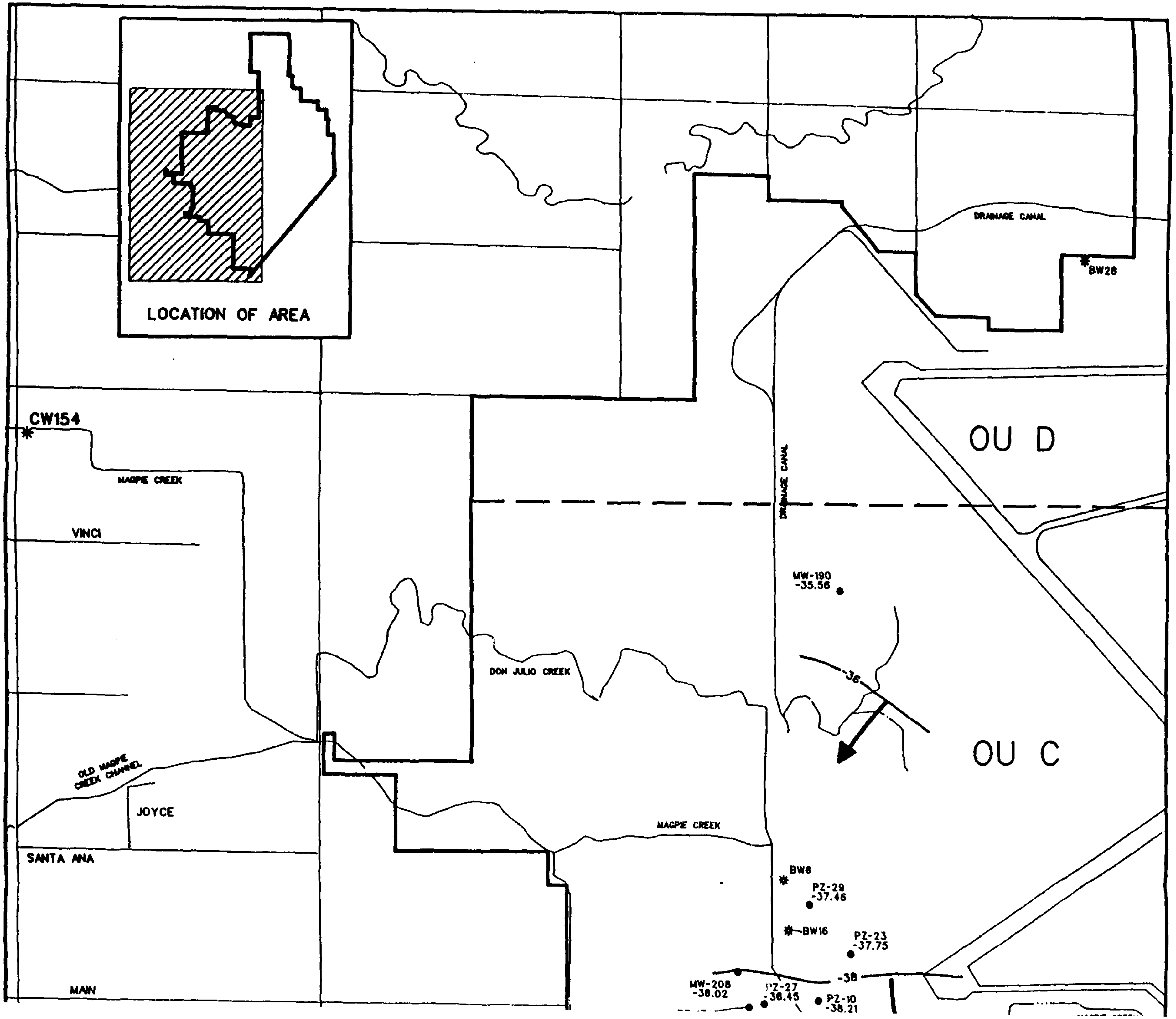


Figure 2-12 Well Locations and Groundwater Contours in the B Monitoring Zone, April 1993

OUC2 GWB SAC 9/18/93



LOCATION OF AREA
OU D
OU C
CW154
MAGPIE CREEK
VINCI
OLD MAGPIE CREEK CHANNEL
JOYCE
SANTA ANA
MAIN
DON JULIO CREEK
MAGPIE CREEK
DRAINAGE CANAL
DRAINAGE CANAL
BW28
MW-190
-35.56
-36
-38
BW6
PZ-29
-37.46
BW16
PZ-23
-37.75
MW-208
-38.02
PZ-27
-38.45
PZ-10
-38.21

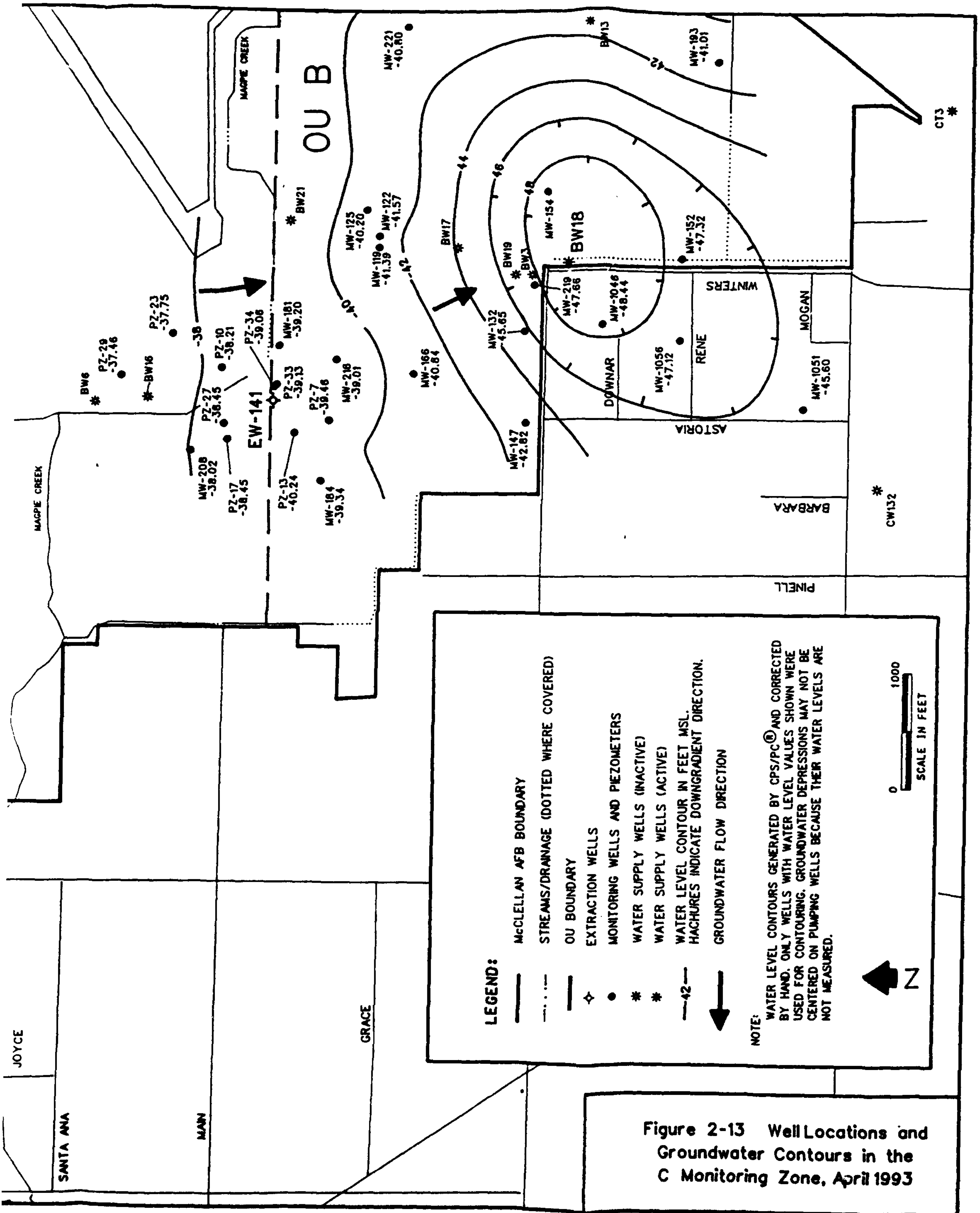


Figure 2-13 Well Locations and Groundwater Contours in the C Monitoring Zone, April 1993

(2)

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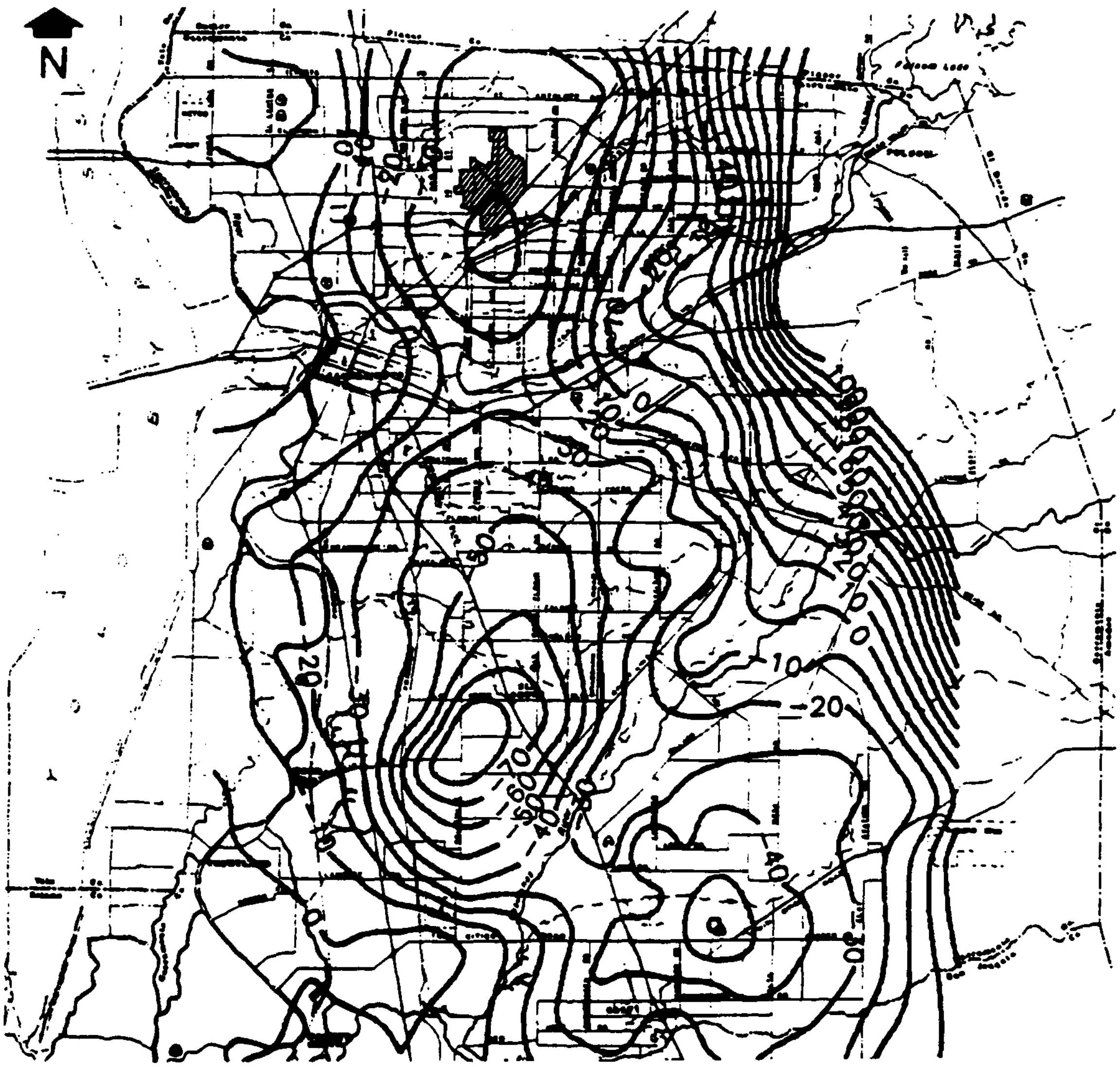

LEGEND

—— Groundwater Contours

– –20 – Elevation (Feet Mean Sea Level)

Figure 2-14. Water Level Contours Showing Regional Groundwater Depression

SOURCE: County of Sacramento Department of Public Works Water Resources Division, 1989

OUCSAP - VMG 9/24/93 SAC

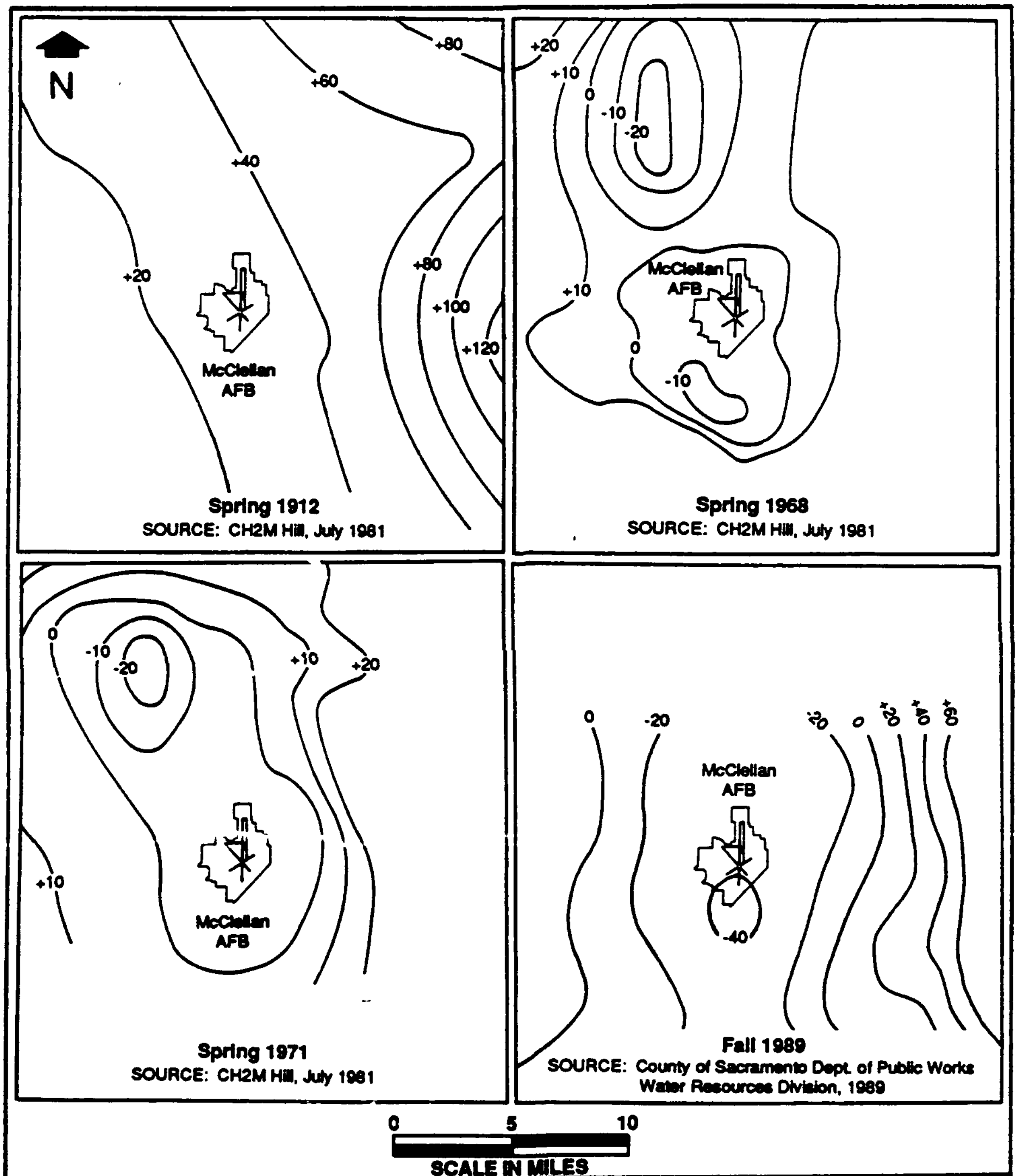

Figure 2-15. Groundwater Contours (Above Mean Sea Level) in the Vicinity of McClellan AFB

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influence of the extraction wells does not extend into OU C. *Groundwater divides must be present in the A and B zones between the OU D groundwater depression and the northern portion of OU C; however, the existing array of monitoring wells in northern OU C and southern OU D is not adequate to define the divides.*

Groundwater pumping from off-base City of Sacramento Supply Well (CW)-154 results in a northwesterly flow in the A and B northernmost portion of OU C. Further south, the hydraulic influence of CW-154 diminishes, and groundwater in the two zones is drawn to the south by the regional hydraulic gradient (Figures 2-11 and 2-12). *There is no other groundwater extraction for municipal or residential water uses within 2,000 feet of the western McClellan AFB boundary. All residences in the off-base area were connected to municipal water supplies for potable water in 1986.* All active private wells in the area are used for agricultural purposes only.

In central OU C, four extraction wells (EWs) create local hydraulic influence on groundwater flow in the A, B, and C zones (Figures 2-11, 2-12, and 2-13). Extraction Well-137, EW-140, EW-141, and EW-144, began extracting groundwater in 1988 along the axis of a plume consisting of dissolved TCE and other volatile organic compounds (VOCs). Contaminated groundwater from the plume is drawn toward the wells. Groundwater outside the hydraulic influence of the wells is drawn to the southeast toward the groundwater depression at BW-18.

Groundwater pumped by extraction wells at McClellan AFB is treated to remove contaminants and discharged into Magpie Creek, which flows toward the McClellan AFB boundary and off base to the west. No groundwater in OU C is extracted for industrial or residential uses. There are two former supply well locations within OU C, BW-6 and BW-16; however, there are no records indicating when or if the wells were operated to supply water to McClellan AFB. Some wells with a BW designation were domestic or agricultural supply wells that were present when the Air Force purchased land for the Sacramento Air Depot in the 1930s. There are also no records indicating that the wells were properly abandoned (Ludorff and Scalmanini, 1984). Both BW-6 and BW-16 will be investigated by the McClellan AFB Well Abandonment Program to determine what future action, if any, should be taken. Base Well-16 is scheduled in the program's current phase, whereas BW-6 will be included in a subsequent phase.

2.3 OU C Operational History

Although operations at McClellan AFB began in the late 1930s, most of the activity in OU C began in the 1950s. The area has primarily been used for waste disposal, aircraft testing and repair, industrial wastewater and groundwater treatment, open storage, ground support engine repair, fire-training, and aircraft painting (Figure 2-16). As a result of the activities in OU C, toxic and hazardous substances have been used, stored, and locally disposed. The types of substances include:

- Industrial solvents containing VOCs;
- Semivolatile organic compounds (SVOCs);
- Acids and bases;
- Oils contaminated with polychlorinated biphenyls (PCBs) and polycyclic aromatic hydrocarbons (PAHs);
- Jet fuel;
- Dioxins/furans;
- Inorganics;

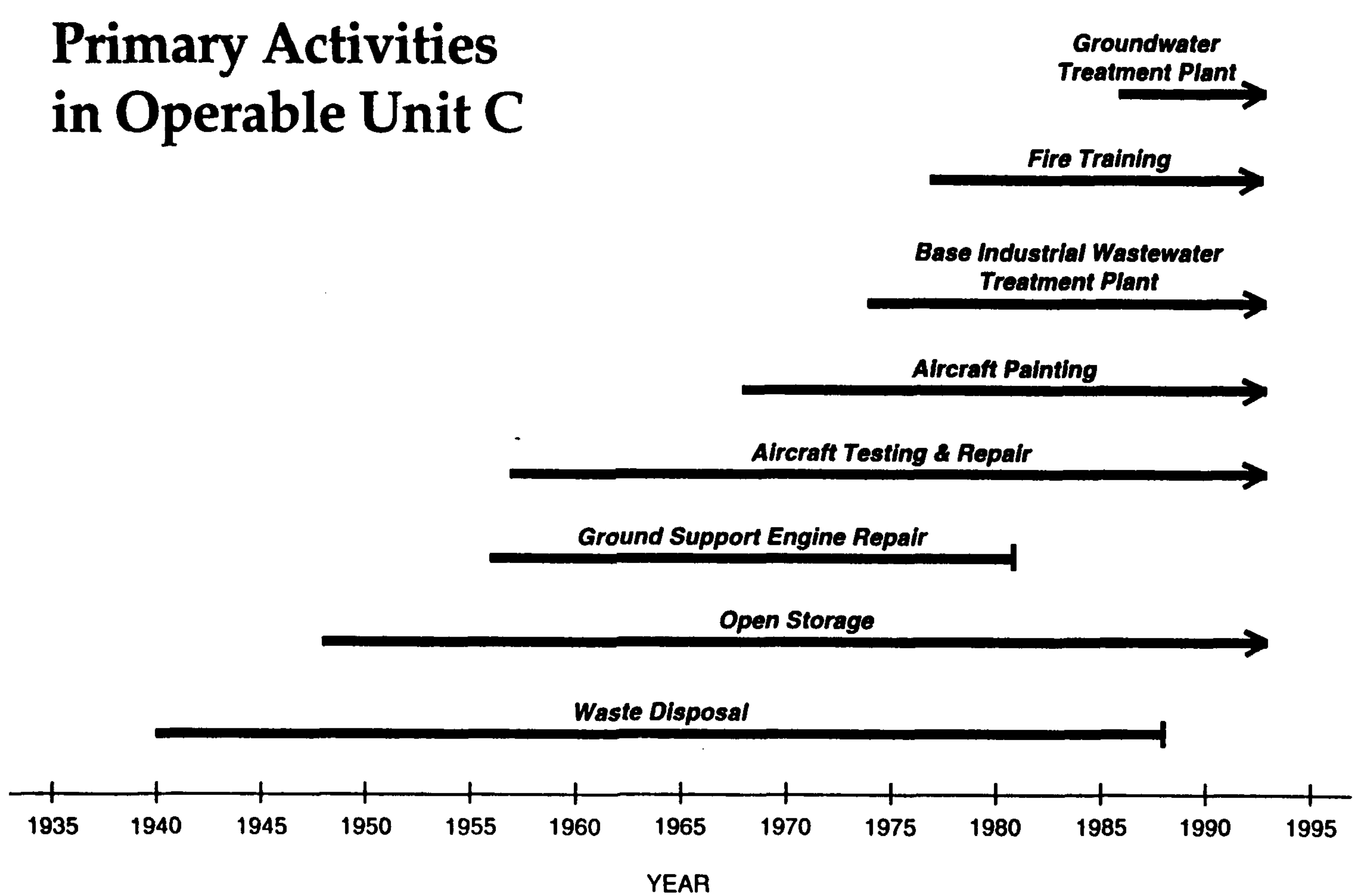

Figure 2-16. Primary Activities in Operable Unit C

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- Automotive fuel;
- Oils and lubricants; and
- Radionuclides.

A number of compounds associated with these substances have been detected in OU C soils, stream sediment, surface water, soil gas, and groundwater. The activities that resulted in these discharges were, at the time, considered acceptable. A list of all compounds detected in OU C is included in Table 2-1.

2.3.1 Use, Storage, and Disposal of Chemicals

The current and historical use, storage, and disposal of substances in OU C are specified by location in Table 2-2. These locations, shown in Figure 2-17, include Confirmed Sites (CSs), Potential Release Locations (PRLs), and other areas being investigated and have been grouped into Investigation Clusters (ICs) to facilitate the RI process. The use or storage of materials at these locations does not necessarily indicate that these chemicals have been released to the environment.

2.3.2 Previous Investigations

Large-scale investigations that addressed contamination in OU C and their findings are summarized in Table 2-3. Small scale investigations conducted in OU C are not listed on the table but are identified in the location-specific field sampling plans (Section 5).

The maximum concentration of contaminants reported at each investigative area during previous investigations is summarized in Table 2-4. Contaminant concentrations are given for each medium and the depth and boring in which they were reported is shown. Reference the indicated report and page number for complete analytical results of previous investigations.

TABLE 2-1. COMPOUNDS PREVIOUSLY DETECTED IN OU C

Volatile Organic Compounds
- Acetone
- Benzene
- 2-Butanone
- Chlorobenzene
- Chloroform
- 1,1-Dichloroethane
- 1,2-Dichloroethane
- 1,1-Dichloroethene
- Dichloromethane
- 1,2-Dichloropropane
- 1,3-Dichloropropylene
- Ethylbenzene
- 2-Hexanone
- Methylene chloride
- 1,1,2,2-Tetrachloroethane
- Tetrachloroethene
- Toluene
- Total xylenes
- trans-1,2-Dichloroethene
- 1,1,1-Trichloroethane
- Trichloroethene
- Vinyl chloride

Semivolatile Organic Compounds
- Acenaphthene
- Acenaphthylene
- Anthracene
- Benzo(a)anthracene
- Benzo(a)pyrene
- 3,4-Benzofluoranthene
- Benzo(g,h,i)perylene
- Benzoic acid
- Benzo(k)fluoranthene
- Benzyl alcohol
- bis(2-ethylhexyl)phthalate
- Butyl benzyl phthalate
- 4-Chloroaniline
- Chloroaniline
- Chlorobenzene
- 2-Chlorothylvinyl ether
- Chrysene
- Dibenzo(a,h)anthracene
- Dibenzofuran
- 1,2-Dichlorobenzene
- 1,3-Dichlorobenzene
- 1,4-Dichlorobenzene
- 3,3-Dichlorobenzidine
- Dichlorobromomethane
- Diethyl phthalate
- Dimethyl phthalate
- 2,4-Dimethylphenol
- Dimethyl phthalate
- Di-n-butyl phthalate
- Di-n-octyl phthalate
- 2,4-Dinitrotoluene
- 2,6-Dinitrotoluene
- Fluoranthene
- Fluorene

Semivolatile Organics Compounds (Continued)
- Hexachloroethane
- Indeno(1,2,3-cd)pyrene
- 2-Methyl naphthalene
- 4-Methyl-2-pentanone
- 2-Methylphenol
- 4-Methylphenol
- Naphthalene
- Nitrobenzene
- 4-Nitrophenol
- N-nitrosodi-n-propylamine
- N-nitrosodiphenylamine
- Pentachlorophenol
- Phenanthrene
- Phenol
- Pyrene
- Styrene
- 1,2,4-Trichlorobenzene

Pesticides/PCBs
- PCB Aroclor 1254
- PCB Aroclor 1260
- Chlordane
- 4,4′-DDD
- 4,4′-DDE
- Endosulfan I
- Endosulfan sulphate

Other Hydrocarbons
- *Grease and oil*
- Hydrocarbons (ppm)

Inorganic Species
- Aluminum
- Arsenic
- Antimony
- Barium
- Beryllium
- Cadmium
- Calcium
- Chromium
- Cobalt
- Copper
- Cyanide
- Iron
- Lead
- Magnesium
- Manganese
- Molybdenum
- Mercury
- Nickel
- Potassium
- Selenium
- Silver
- Sodium
- Thallium
- Vanadium
- Zinc

TABLE 2-2. USE, STORAGE, AND DISPOSAL OF MATERIALS IN OU C

Location	Type of Site	Period of Operation	Wastes Potentially Released	Phase I Potential COCs	Current Status
IC 9[a]					
PRL S-31	Buildings 691 and 692; Aircraft painting	1968 to present	Stripping sludges.	VOCs, SVOCs, inorganic species, cyanide	Buildings 691 and 692 are active.
PRL S-32	Building 694; Hazardous waste storage	1970 to present	Acids, PCB-contaminated oil, alkali solutions, cyanide, paint, lubricants, and solvents.	VOCs, SVOCs, PCBs, dioxins/furans, inorganic species, cyanide, acids, bases, TPH	Used as hazardous waste storage area.
PRL 65	Surface depression	1940s to 1960s	Unknown	VOCs, SVOCs, inorganic species, TPH	Part of the site was excavated for realignment of Magpie Creek. Portions are covered by Building 694, the hazardous waste storage area, and a concrete taxiway.
Magpie Creek	Creek	1940s to present	TPH, SVOCs, inorganic species, PAHs	TPH, SVOCs, inorganic species, PAHs	Active
IC 10					
PRL S-11	Building 636; Ground support,	1956 to present	PCB-contaminated oils, automotive oil, lubricants, solvents.	VOCs, TPH, PCBs, inorganic species	Nonhazardous materials are stored in Building 636. Area is not being used for engine repair.
	Engine repair	1956 to 1980			
Tank 6008	UST; Diesel fuel	Unknown to 1988	Diesel, SVOCs	VOCs, TPH	Removed in 1988.
Building 635	Aero Club	1983 to present	Aviation fuel, solvents, and TPH.	VOCs, TPH, BTEX	Active

(Continued)

TABLE 2-2. (Continued)

Location	Type of Site	Period of Operation	Wastes Potentially Released	Phase I Potential COCs	Current Status
<u>IC 11</u>[a]					
PRL 32	Hazardous and radioactive waste storage area	1956 to 1978	VOCs, SVOCs, inorganic species, radionuclides, mercury	VOCs, SVOCs, inorganic species, radionuclides, mercury	Open field and parking lot.
PRL 56	Surface storage area	Late 1940s through 1978	Treated IWTP effluent.	VOCs, SVOCs, inorganic species	Unused, except for gravel stockpiles in southeast corner.
PRL 57	Excavation	1956 to 1963	No waste disposal, but runoff from PRL 56 may have reached PRL 57.	SVOCs, inorganic species	Open field.
Tank 737	UST; Diesel fuel	1984 to present	Diesel fuel, VOCs.	TPH, VOCs	Scheduled to be removed in 1993.
Magpie Creek	Creek	1940s to present	SVOCs, TPH, inorganic species	SVOCs, TPH, inorganic species	Active.
<u>IC 12</u>					
PRL L-7A	Industrial wastewater line	1974 to present	Industrial wastewater leaking from pipeline.	VOCs	Pipeline operating leaks reportedly repaired.
PRL S-48	Drainage	1957 to 1973	Jet fuels, hydraulic fluids, oils, and solvents in surface water.	VOCs, SVOCs, TPH, inorganic species	No active use, but still receives some drainage.
PRL 66A	Drainage	1957 to present	Jet fuels, hydraulic fluids, oils, solvents, and inorganic species.	VOCs, SVOCs, TPH, inorganic species	In use

(Continued)

TABLE 2-2. (Continued)

Location	Type of Site	Period of Operation	Wastes Potentially Released	Phase I Potential COCs	Current Status
IC 13[a]					
PRL 18	Burial pit	1957 to 1959	Burn debris from burning pit and tepee burner, unknown chemical wastes.	VOCs, SVOCs, inorganic species	Open field used by Base Civil Engineering for storage of construction material.
PRL 19	Burial pit	1957 to 1959	Burn debris from burning pit and tepee burner, unknown chemical wastes.	VOCs, SVOCs, inorganic species	Open field used by Base Civil Engineering for storage of construction material.
PRL 54	Bermed area	Unknown, likely during 1960s	Unknown	Unknown	Used by Base Civil Engineering for storage of construction materials.
PRL 55	Acid storage and burial pit	1950s to late 1960s	Battery acid wastes, unknown chemical wastes.	Acids, VOCs, inorganic species, TPH, SVOCs	Storage of clean soil.
Former gas station	Gas station	1940s; exact dates unknown	Gasoline, diesel	TPH, organic lead, SVOCs, BTEX	Clean soil storage. Surface features demolished; tanks may still be in place.
Former Magpie Creek Channel	Creek	1940s to present	TPH, SVOCs, inorganic species	TPH, SVOCs, inorganic species	Creek course was altered and channel has been backfilled.
IC 14					
PRL L-7B	Industrial wastewater line	1974 to present	Industrial wastewater leaking from pipeline.	VOCs, SVOCs, inorganic species, TPH	Pipeline operating; leaks were repaired in 1988. A blockage in the line was identified in 1993 and removed.
PRL 17	Burial pit	1957 to 1959	Burn debris from burning pit and tepee burner, other wastes.	VOCs, SVOCs, TPH, inorganic species	Covered with aeration and blending tanks for IWTP.
PRL 20	Sludge/oil pit	1956 and 1957	Industrial waste sludge, possible waste oil, plating shop sludge.	VOCs, SVOCs, TPH, inorganic species	Partially covered by GWTP.

(Continued)

TABLE 2-2. (Continued)

Location	Type of Site	Period of Operation	Wastes Potentially Released	Phase I Potential COCs	Current Status
IC 14 (Continued)					
PRL 21	Sludge/oil pit	1956 and 1957	Industrial waste sludge, possible waste oil, plating shop sludge	VOCs, SVOCs, TPH, inorganic species	Storage of construction material by Base Civil Engineering.
PRL 63	Drainage	1957 to present	Jet fuels, hydraulic fluids, oils, solvents, inorganic species.	SVOCs, TPH, inorganic species	In use
PRL 64	Drainage	1957 to present	Jet fuels, hydraulic fluids, oils, and solvents, inorganic species.	SVOCs, TPH, inorganic species	In use
PRL 66B	Drainage	1957 to present	Jet fuels, hydraulic fluids, oils, solvents, and inorganic species.	VOCs, SVOCs, TPH, inorganic species	In use
Tank 714	UST; Chemical/waste oil	1972 to *1989*	*Oil; unknown other* chemicals.	VOCs, SVOCs, TPH, PAHs, inorganic species	Removed in 1989.
Free Oil Tank	Aboveground tank	1970s to present	Waste oil	TPH, SVOCs, PAHs, VOCs, PCBs, dioxins/furans	Active
IC 15[a]					
PRL P-10	Magpie Creek	Natural drainage that was operated as an industrial ditch from the late 1930s to 1986.	In the past, Magpie Creek was used for disposal of untreated waste streams from the Air Force Base; now only stormwater is discharged into the creek.	VOCs, SVOCs, TPH, inorganic species, radionuclides	Active

(Continued)

TABLE 2-2. (Continued)

Location	Type of Site	Period of Operation	Wastes Potentially Released	Phase I Potential COCs	Current Status
IC 15 (Continued)					
PRL 28	Skimming basin	1945 to present	Industrial wastewater and treated industrial wastewater	VOCs, SVOCs, PCBs, TPH, radionuclides, inorganic species, PAHs, dioxins/furans	Active; Magpie Creek water only
PRL 60	Oxidation lagoons	1957 to present	Treated industrial wastewater	VOCs, SVOCs, PCBs, TPH, radionuclides, inorganic species	Storage of Magpie Creek water
IC 16[b]					
PRL 50	Settling pond	1956 to 1959	Unknown	Unknown	Dirt turnout on road.
PRL 51	Holding ponds	1980 to present	Treated effluent	VOCs, SVOCs, PCBs, TPH, inorganic species, cyanide	Storage of rain water
Don Julio Creek	Creek	1950s to present	SVOCs, TPH, inorganic species	SVOCs, TPH, inorganic species	Active
IC 17[b]					
CS 43	Burial and burn pit	1947 to 1963	VOCs, SVOCs, PCBs, TPH, inorganic species, PAHs, dioxins/furans	VOCs, SVOCs, PCBs, TPH, inorganic species, PAHs, dioxins/furans	Open field covered with vegetation.
CS 52	Burial and burn pit	1956 to 1959	VOCs, SVOCs, PCBs, TPH, inorganic species, PAHs, dioxins/furans	VOCs, SVOCs, PCBs, TPH, inorganic species, PAHs, dioxins/furans	Partially covered with taxiway and road.
CS 67	Burial pit	1956 to 1963	VOCs, SVOCs, PCBs, TPH, inorganic species, PAHs, dioxins/furans	VOCs, SVOCs, PCBs, TPH, inorganic species, PAHs, dioxins/furans	Open field covered with vegetation.
PRL 15	Sodium valve trench	1940s and 1950s	Sodium valves from aircraft engines and other unknown wastes	VOCs, TPH, inorganic species	Open field covered with vegetation.

(Continued)

TABLE 2-2. (Continued)

Location	Type of Site	Period of Operation	Wastes Potentially Released	Phase I Potential COCs	Current Status
IC 17 (Continued)					
PRL 16	Sodium valve trench	1940s and 1950s	Sodium valves from aircraft engines and other unknown wastes	VOCs, TPH, inorganic species	Open field covered with vegetation.
Tank 702	UST; Diesel fuel	1959 to 1989	Diesel, VOCs	VOCs, TPH	Removed in 1989.
Don Julio Creek	Creek	1950s to present	SVOCs, TPH, inorganic species	SVOCs, TPH, inorganic species	Active
Drainage Ditch	Ditch	Natural drainage — portions may have been altered since the 1930s	SVOCs, TPH, inorganic species	SVOCs, TPH, inorganic species	Active
IC 18					
PRL L-7C	Industrial wastewater collection line	1988 to present	Industrial wastewater leaking from pipeline.	VOCs	Pipeline operating.
PRL 49	Burial pit	Unknown	Unknown	Unknown	Unused
PRL 66C	Drainage	1957 to present	Jet fuels, hydraulic fluids, oils, solvents, and inorganic species.	VOCs, SVOCs, TPH, inorganic species	In use
Drainage Ditch	Ditch	1989 to present	SVOCs, TPH, inorganic species	SVOCs, TPH, inorganic species	Active
IC 19[b]					
CS 10	Landfill	1949 to 1957	Burial pits for ash, general refuse, contaminated soil storage.	VOCs, SVOCs, PAHs, TPH, PCBs, dioxins/furans, inorganic species, cyanide	Unused
CS 11	Landfill; Former fire training; Contaminated soil holding	1965 to 1966 1977 to 1987 1987 to present	Burial pits for ash, burned debris, general refuse, discharged lubricants, hydrocarbons.	VOCs, SVOCs, PAHs, TPH, PCBs, dioxins/furans, inorganic species, cyanide	Contaminated soil storage from various areas on McClellan AFB before off-site disposal.

(Con l)

TABLE 2-2. (Continued)

Location	Type of Site	Period of Operation	Wastes Potentially Released	Phase I Potential COCs	Current Status
IC 19 (Continued)					
CS 12	Landfill; Former fire training; Contaminated soil holding	1966 to 1971 1971 to 1987 1987 to present	Burial pits for ash, burned debris, general refuse, discharged lubricants.	VOCs, SVOCs, PAHs, TPH, PCBs, dioxins/furans, inorganic species, cyanide	Contaminated soil storage from various areas on McClellan AFB before off-site disposal.
CS 13	Landfill;	1969 to 1971	Burial pits for ash, burned debris, general refuse, discharged lubricants.	VOCs, SVOCs, PAHs, TPH, PCBs, dioxins/furans, inorganic species, cyanide	Unused
CS 14	Landfill	1971 to 1975	Burial pits for ash, general refuse.	VOCs, SVOCs, PAHs, TPH, PCBs, dioxins/furans, inorganic species	Area scheduled to be paved.
IC 20					
PRL L-7D	Industrial wastewater line	1988 to present	Industrial wastewater leaking from pipeline.	VOCs	Pipeline operating.
PRL 9	Burial pit	Unknown	Unknown	Unknown	Unused
PRL S-46	Drainage	Unknown	Unknown	Unknown	In use
PRL 66D	Drainage	1957 to present	Jet fuels, hydraulic fluids, oils, solvents, and inorganic species.	VOCs, SVOCs, TPH, inorganic species	In use
Drainage Ditch	Ditch	1989 to present	SVOCs, TPH, inorganic species	SVOCs, TPH, inorganic species	Active

(Continued)

TABLE 2-2. (Continued)

Location	Type of Site	Period of Operation	Wastes Potentially Released	Phase I Potential COCs	Current Status
IC 21[b]					
CS 7	Landfill	Unknown; estimates range from 1962 to mid-1970s	Sludges, debris, batteries, possible oil burn pit, solvents, medical supplies, oil, plastics.	VOCs, SVOCs, PAHs, PCBs, TPH, dioxins/furans, inorganic species, cyanide, acids/bases	Open field covered with vegetation.
PRL 8	Landfill	1974 to 1988	Industrial sludge, construction debris; potentially any waste generated on base.	VOCs, SVOCs, PAHs, PCBs, Pesticides, cyanide, inorganic species, TPH, dioxins/furans	Open field covered with vegetation, occasionally used for military exercises; covered by 3 feet of compacted fill; under an act of RWQCB closure requirements.
Firing Range	Firing range	1964 to present	Lead and copper bullets, SVOCs	Total and soluble lead and copper, SVOCs	Active
Tank 701	UST; Diesel fuel	1954 to 1990	Diesel, VOCs	VOCs, TPH	Removed in 1990.
Tank 712	UST; Diesel fuel	1943 to 1984	Diesel, VOCs	VOCs, TPH	Removed in 1984.
PRL S-10					
PRL S-10	Hazardous waste and radioactive storage	1973 to present	Radioactive wastewater, solvents, PCB-contaminated oil.	VOCs, SVOCs, PCBs, acids, bases, cyanide, inorganic species, radionuclides	Storage of low-level radioactive waste.
PRL 53[b]					
PRL 53	Settling pond	1956 to 1959	Unknown in settling pond.	Unknown	Part of settling pond covered since 1959 with concrete apron.
Area north of Building 704	Aircraft repair in Building 704	1960 to present	Possible hydrocarbon spills in Building 704, solvents, PCBs.	VOCs, SVOCs, PCBs, TPH, inorganic species	Building 704 used for aircraft maintenance.

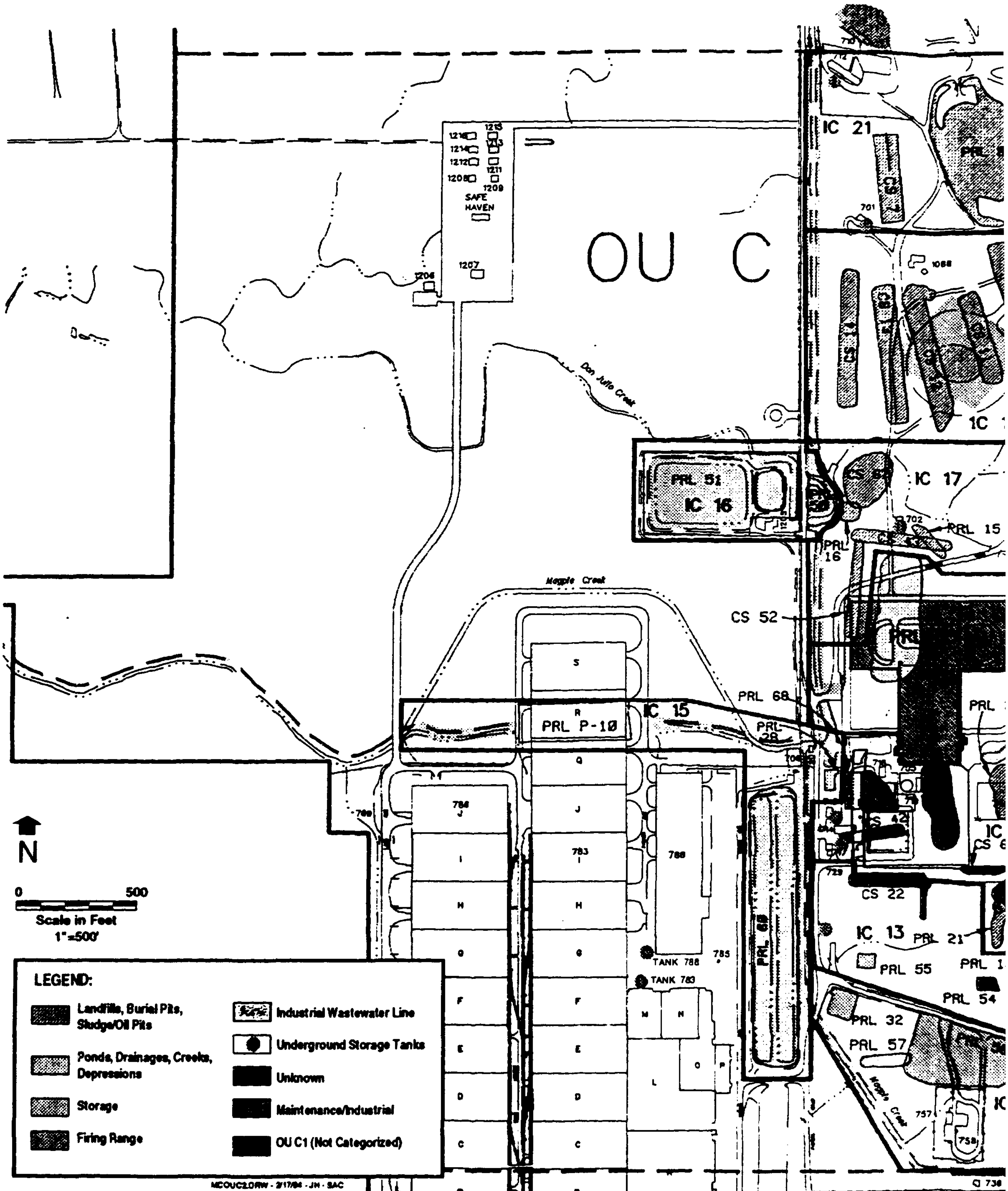
(Continued)

TABLE 2-2. (Continued)

Location	Type of Site	Period of Operation	Wastes Potentially Released	Phase I Potential COCs	Current Status
PRL 53 (Continued)					
Former Firing Range	Firing range	Approximately 1946 to 1959	Lead and copper bullets, SVOCs.	Total and soluble lead and copper, SVOCs	Demolished; covered partially by a dirt road and a concrete apron.
IWL	Industrial Wastewater Line	1974 to present	VOCs	VOCs	Active
Don Julio Creek	Creek	1950s to present	SVOCs, TPH, inorganic species	SVOCs, TPH, inorganic species	Active
Tank 761	UST; Diesel fuel	Unknown to 1990	Diesel, VOCs	VOCs, TPH	Removed in 1990.
Tank 783	UST; Waste fuel	1957 to 1989	VOCs, organic lead, TPH, BTEX	VOCs, TPH, organic lead, BTEX	Removed in 1989.
Tank 788	UST; Acid; Neutralization	Unknown	Acids, bases, inorganic species, VOCs	Acids, bases, inorganic species, VOCs	Unknown.

[a] Magpie Creek also runs through this IC; see description of PRL P-10 in IC 15.
[b] Don Julio Creek runs through this IC.

NOTE: All acronyms are defined on the acronym list in the beginning of the SAP.


OU C
SAFE HAVEN
Don Julio Creek
Magpie Creek
IC 21
IC 17
IC 16
PRL 51
IC 15
PRL P-10
PRL 68
PRL 28
CS 52
CS 42
CS 22
IC 13
PRL 21
PRL 55
PRL 54
PRL 32
PRL 57
PRL 69
PRL 15
PRL 16
TANK 788
TANK 783
N
0 500
Scale in Feet
1"=500'
LEGEND:
Landfills, Burial Pits, Sludge/Oil Pits
Ponds, Drainages, Creeks, Depressions
Storage
Firing Range
Industrial Wastewater Line
Underground Storage Tanks
Unknown
Maintenance/Industrial
OU C1 (Not Categorized)
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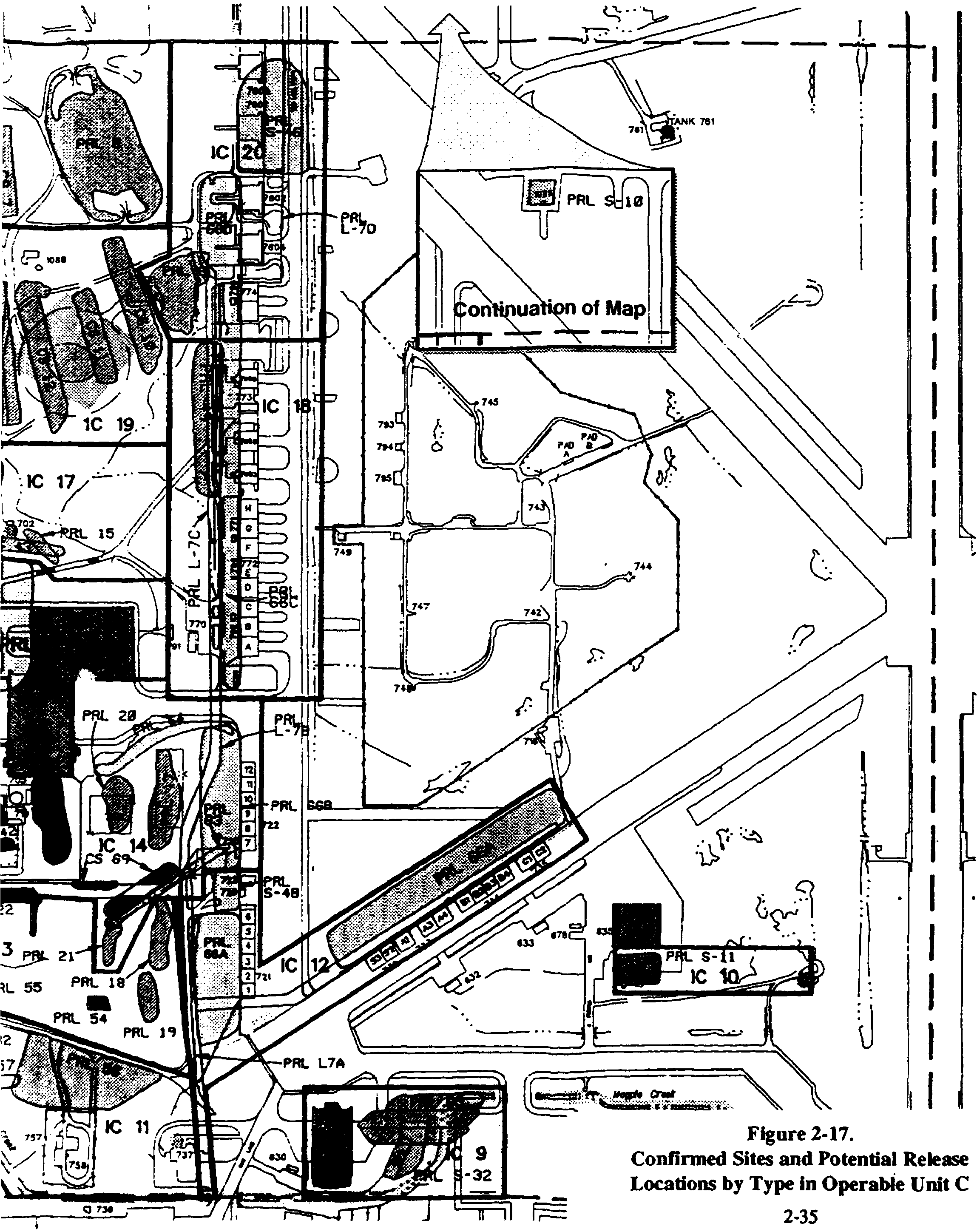

Figure 2-17.
Confirmed Sites and Potential Release Locations by Type in Operable Unit C

(2)

TABLE 2-3. SUMMARY OF MAJOR PREVIOUS INVESTIGATIONS IN OU C AT McCLELLAN AFB

Year	Contractor	Scope	Conclusions
1980	Brunner and Zipfel	Initial investigation into contamination at McClellan AFB.	Identified four areas — A, B, C, and D — to be investigated.
1981	CH2M HILL	IRP Phase I — Initial assessment of contamination.	Identified past disposal sites in all areas of the base.
1983	Engineering Science	IRP Phase II — Defined and quantified contamination; implemented a monitoring program to determine the extent of groundwater contamination.	Base production wells could be serving as conduits for contamination to migrate to deeper aquifers.
1983	Ludorff & Scalmanini	Reviewed previous investigations.	Aquifers are not separated from one another and provide a natural path for contaminant migration.
1984	Radian Corporation	Determined the nature and extent of contamination in off-base wells.	Identified public health hazards and assessed remedial alternatives.
1985	McLaren Environmental Engineering, Inc.	Drilled soil borings to further define the extent of contamination at sites identified during IRP Phase I.	Some sites required further investigation; some required no further investigation.
1986	Radian Corporation	Groundwater Sampling and Analysis Program.	Determine presence and concentration of contaminants and evaluate migration over time (ongoing program).
1988	EG&G Idaho	Characterized the Industrial Wastewater Collection System.	Collected samples and compared results to hazardous waste criteria. Also evaluated the integrity of the collection system piping.
1990	Radian Corporation	Basewide investigation of stream sediments for potential organic and inorganic contamination.	Organic compounds were detected in water samples, and organic compounds and inorganic species above subsurface background concentrations were detected in sediment samples.
1991	Radian Corporation	Conducted the Preliminary Groundwater Operable Unit Investigation.	Developed a conceptual model of the hydrogeology and investigated the extent of groundwater contamination at McClellan AFB.

(Continued)

TABLE 2-3. (Continued)

Year	Contractor	Scope	Conclusions
1992	Radian Corporation	Investigation of Magpie Creek as part of OU B RI	Low levels of petroleum hydrocarbons, toluene, two phthalate compounds, six metals above subsurface background, and beta radioactivity above subsurface background were reported.
1993	U.S. Department of Health and Human Services	Public Health Assessment for McClellan AFB	Defined health risk exposure pathways.
1993	Radian Corporation	Sampling of sediments as part of the OU B1 RI.	PCBs were reported in ditches near OU B1. Sediments from Magpie Creek contained no PCBs or dioxins, but did yield beta radioactivity, cadmium, and lead above subsurface background concentrations.
1993	CH2M HILL	Preliminary assessment of Potential Release Locations and Confirmed Sites in OU C.	Identified areas to be investigated through records review, site visits, and personnel interviews.
1992	Jacobs Engineering	Remedial Investigation of OU C1.	Concentrations of VOCs in soil gas exceed 1,000,000 ppbv beneath some parts of OU C1.
1993	U.S. EPA	Ecological Assessment of McClellan AFB.	Identified four critical habitats at McClellan AFB, including Don Julio Creek and adjacent grasslands containing vernal pools; the Western Collection Ponds (PRL 51); Magpie Creek; and Robla Creek.

NOTE: All acronyms are defined in the acronym list at the beginning of the SAP.

TABLE 2-4. MAXIMUM VOC/SVOC CONCENTRATIONS PREVIOUSLY DETECTED IN OU C

Site	IC	Contaminant	Maximum Concentration (μg/kg)	Sample Depth (ft BGS)	Boring Number	McLaren, 1986 Report Page Number
		Soil Results:				
CS 7	21	Acetone	4,400	39.5 - 40.0	07SSB02	32-33
		Chloroform	220	7.0 - 10.0	07WSB02	32-33
		Chlorobenzene	23	7.0 - 10.0	07WSB02	32-33
		Ethylbenzene	94	5.5 - 30.0	07CWS01	32-33
		Toluene	640	5.5 - 30.0	07CWS01	32-33
		2-Butanone	1,800	39.5 - 40.0	07SSB02	32-33
		2-Hexanone	470	5.5 - 30.0	07CWS01	32-33
		Total xylenes	440	5.5 - 30.0	07CWS01	32-33
		4-Methyl-2-pentanone	210	39.5 - 40.0	07SSB02	32-33
		Methylene chloride	220	69.5 - 70.0	07SSB02	32-33
		Grease and oil (mg/kg)	3,400	5.5 - 30.0	07CWS01	32-33
		Phenol	280	8.5 - 30.0	07WSB04	32-33
		4-Methylphenol	690	8.5 - 30.0	07WSB04	32-33
		PCB Aroclor 1254	2,000	5.5 - 30.0	07CWS01	32-33
		Diethyl phthalate	140	7.0 - 10.0	07WSB02	32-33
		N-nitrosodiphenylamine	100	7.0 - 10.0	07WSB02	32-33
		Phenanthrene	200	7.0 - 10.0	07WSB02	32-33
		Di-n-butyl phthalate	370	5.5 - 30.0	07CWS01	32-33
		bis(2-ethylhexyl)phthalate	19,000	8.5 - 30.0	07WSB04	32-33
		2,6-Dinitrotoluene	120	7.0 - 10.0	07WSB02	32-33
		Butyl benzyl phthalate	230	5.5 - 30.0	07CWS01	32-33
		Soil Results:				
PRL 8	21	Benzene	22	23.0 - 23.5	08WSB04	36
		Toluene	89	59.0 - 59.5	08CWS01	36
		trans-1,2-Dichloroethylene	140	59.0 - 59.5	08CWS01	36
		Acetone	320	59.5 - 60.0	08SSB01	36
		2-Butanone	210	59.5 - 60.0	08SSB01	36
		Grease and oil (mg/kg)	6,170	5.5 - 21.5	08WSB04	36
		Diethyl phthalate	160	5.5 - 21.5	08WSB04	36
		Phenanthrene	120	5.5 - 21.5	08WSB04	36
		Di-n-butyl phthalate	380	5.5 - 21.5	08WSB04	36
		bis(2-ethylhexyl)phthalate	570	6.0 - 18.0	08CWS01	36

TABLE 2-4. (Continued)

Site	IC	Contaminant	Maximum Concentration (µg/kg)	Sample Depth (ft BGS)	Boring Number	McLaren, 1986 Report Page Number
PRL 8 (Continued)						
		Chrysene	140	5.5 - 21.5	08WSB04	36
		Di-n-octyl phthalate	130	5.5 - 21.5	08WSB04	36
		Dibenzo(a,h)anthracene	1,500	6.0 - 18.0	08CWS01	36
		3,4-Benzofluoranthene	560	6.0 - 18.0	08CWS01	36
		Indeno(1,2,3-cd)pyrene	1,200	6.0 - 18.0	08CWS01	36
		Benzo(a)pyrene	430	59.0 - 60.0	08SSB01	36
		Soil Results:				
PRL 9	20	Toluene	17	31	09WSB02	Appendix 2
		Soil Results:				
CS 10	19	Chloroform	890	6.0 - 12.5	10WSB01	45-46
		Chlorobenzene	32	6.0 - 12.5	10WSB01	45-46
		Toluene	160	6.0 - 12.5	10WSB01	45-46
		4-Methyl-2-pentanone	160	6.0 - 12.5	10WSB01	45-46
		Acetone	240	34.5 - 35.0	10SSB01	45-46
		2-Hexanone	30	6.0 - 12.5	10WSB01	45-46
		Total xylenes	22	6.0 - 12.5	10WSB01	45-46
		Trichloroethylene	33	6.0 - 9.5	10WSB02	45-46
		Methylene chloride	110	11.5 - 21.0	10CWS01	45-46
		Pentachlorophenol	1,600	6.0 - 12.5	10WSB01	45-46
		2-Methyl naphthalene	140	6.0 - 12.5	10WSB01	45-46
		PCB Aroclor 1260	150,000	6.0 - 12.5	10WSB01	45-46
		Grease and oil (mg/kg)	34,500	6.0 - 12.5	10WSB01	45-46
		Phenol	370	11.5 - 21.0	10CWS01	45-46
		Benzyl alcohol	340	11.5 - 21.0	10CWS01	45-46
		Naphthalene	210	6.0 - 12.5	10WSB01	45-46
		Acenaphthalene	140	6.0 - 12.5	10WSB01	45-46
		Dimethyl phthalate	240	6.0 - 12.5	10WSB01	45-46
		2,6-Dinitrotoluene	650	6.0 - 12.5	10WSB01	45-46
		Fluorene	230	6.0 - 12.5	10WSB01	45-46
		Pyrene	930	6.0 - 12.5	10WSB01	45-46
		bis(2-ethylhexyl)phthalate	12,000	6.0 - 12.5	10WSB01	45-46
		Chrysene	400	6.0 - 12.5	10WSB01	45-46
		Di-n-butyl phthalate	1,400	6.0 - 12.5	10WSB01	45-46

TABLE 2-4. (Continued)

Site	IC	Contaminant	Maximum Concentration (μg/kg)	Sample Depth (ft BGS)	Boring Number	McLaren, 1986 Report Page Number
CS 10 (Continued)						
		1,3-Dichlorobenzene	110	11.5 - 21.0	10CWS01	45-46
		1,2-Dichlorobenzene	430	11.5 - 21.0	10CWS01	45-46
		Diethyl phthalate	470	6.0 - 12.5	10WSB01	45-46
		Phenanthrene	500	6.0 - 12.5	10WSB01	45-46
		Anthracene	110	6.0 - 12.5	10WSB01	45-46
		Fluoranthene	380	6.0 - 12.5	10WSB01	45-46
		Soil Results:				
CS 11	19	Acetone	3,700	34.5 - 35.0	11SSB01	50-51
		Chlorobenzene	380	11.0 - 14.5	11WSB01	50-51
		Chloroform	140	11.0 - 14.5	11WSB01	50-51
		Methylene chloride	260	10.0 - 10.5	11WSB02	50-51
		Ethylbenzene	480	15.5 - 24.0	11CWS01	50-51
		Toluene	120	11.0 - 14.5	11WSB01	50-51
		Total xylenes	72	15.5 - 24.0	11CWS01	50-51
		2-Butanone	190	34.5 - 35.0	11SSB01	50-51
		Benzoic acid	45,000	15.5 - 24.0	11CWS01	50-51
		Benzyl alcohol	180	11.0 - 14.5	11WSB01	50-51
		Phenol	540	11.0 - 14.5	11WSB01	50-51
		Pentachlorophenol	470	11.0 - 14.5	11WSB01	50-51
		2-Methyl naphthalene	810	15.5 - 24.0	11CWS01	50-51
		2-Methylphenol	870	15.5 - 24.0	11CWS01	50-51
		2,4-Dimethylphenol	2,000	15.5 - 24.0	11CWS01	50-51
		4-Methylphenol	1,200	15.5 - 24.0	11CWS01	50-51
		Dibenzofuran	260	15.5 - 24.0	11CWS01	50-51
		Endosulfan I	20	10.0 - 10.5	11WSB02	50-51
		Grease and oil (mg/kg)	8,100	15.5 - 24.0	11CWS01	50-51
		bis(2-ethylhexyl)phthalate	50,000	15.5 - 24.0	11CWS01	50-51
		Butyl benzyl phthalate	120	11.0 - 14.5	11WSB01	50-51
		Diethyl phthalate	140	15.5 - 24.0	11CWS01	50-51
		Dimethyl phthalate	340	11.0 - 14.5	11WSB01	50-51
		Di-n-butyl phthalate	3,100	15.5 - 24.0	11CWS01	50-51
		Fluorene	240	15.5 - 24.0	11CWS01	50-51
		Fluoranthene	2,900	15.5 - 24.0	11CWS01	50-51

TABLE 2-4. (Continued)

Site	IC	Contaminant	Maximum Concentration (μg/kg)	Sample Depth (ft BGS)	Boring Number	McLaren, 1986 Report Page Number
CS 11 (Continued)						
		Naphthalene	440	11.0 - 14.5	11WSB01	50-51
		N-nitrosodiphenylamine	400	11.0 - 14.5	11WSB01	50-51
		Phenanthrene	370	15.5 - 24.0	11CWS01	50-51
		Pyrene	240	15.5 - 24.0	11CWS01	50-51
		1,2-Dichlorobenzene	6,000	11.0 - 14.5	11WSB01	50-51
		1,3-Dichlorobenzene	1,900	11.0 - 14.5	11WSB01	50-51
		1,4-Dichlorobenzene	4,200	11.0 - 14.5	11WSB01	50-51
		1,2,4-Trichlorobenzene	270	11.0 - 14.5	11WSB01	50-51
		3,4-Benzofluoranthene	630	34.5 - 35.0	11SSB03	50-51
		Soil Results:				
CS 12	19	Acetone	1,100	39.5 - 40.0	12SSB05	57-58
		Chlorobenzene	7,300	27.0 - 27.5	12CWS01	57-58
		Chloroform	45	39.5 - 40.0	12SSB05	57-58
		Methylene chloride	210	9.5 - 25.5	12CWS01	57-58
		Ethylbenzene	270	27.0 - 27.5	12CWS01	57-58
		Styrene	13	9.5 - 25.0	12WSB01	57-58
		Toluene	260	9.5 - 25.0	12WSB01	57-58
		Total xylenes	1,400	27.0 - 27.5	12CWS01	57-58
		Tetrachloroethylene	14	9.5 - 25.0	12WSB01	57-58
		Trichloroethylene	1,700	39.5 - 40.0	12SSB05	57-58
		1,1-Dichloroethylene	2,200	39.5 - 40.0	12SSB05	57-58
		1,1-Dichloroethane	26	39.5 - 40.0	12SSB05	57-58
		1,1,1-Trichloroethane	10	9.5 - 25.5	12CWS01	57-58
		1,2-Dichloroethane	16	39.5 - 40.0	12SSB05	57-58
		1,1,2,2-Tetrachloroethane	19	79.5 - 80.0	12SSB05	57-58
		2-Butanone	260	34.5 - 35.0	12SSB04	57-58
		Benzoic acid	350	9.5 - 25.5	12CWS01	57-58
		Benzyl alcohol	150	9.5 - 25.0	12WSB01	57-58
		Phenol	260	9.5 - 25.0	12WSB01	57-58
		2-Methyl naphthalene	740	9.5 - 25.0	12WSB01	57-58
		4-Nitrophenol	3,300	9.5 - 25.0	12WSB01	57-58
		Dibenzofuran	3,500	9.5 - 25.0	12WSB01	57-58

TABLE 2-4. (Continued)

Site	IC	Contaminant	Maximum Concentration ($\mu g/kg$)	Sample Depth (ft BGS)	Boring Number	McLaren, 1986 Report Page Number
CS 12 (Continued)						
		Endosulfan I	40	9.5 - 25.0	12WSB01	57-58
		Endosulfan sulphate	670	9.5 - 25.0	12WSB01	57-58
		Grease and oil (mg/kg)	10,500	9.5 - 25.0	12WSB01	57-58
		Acenaphthene	3,200	9.5 - 25.0	12WSB01	57-58
		Acenaphthylene	310	9.5 - 25.0	12WSB01	57-58
		N-nitrosodiphenylamine	110	5.5 - 6	12WSB02	57-58
		Anthracene	5,900	9.5 - 25.0	12WSB01	57-58
		Benzo(a)anthracene	13,000	9.5 - 25.0	12WSB01	57-58
		Benzo(g,h,i)perylene	4,100	9.5 - 25.0	12WSB01	57-58
		Butyl benzyl phthalate	740	9.5 - 25.0	12WSB01	57-58
		Chrysene	12,000	9.5 - 25.0	12WSB01	57-58
		Dibenzo(a,h)anthracene	1,200	9.5 - 25.0	12WSB01	57-58
		Diethyl phthalate	260	9.5 - 25.0	12WSB01	57-58
		Dimethyl phthalate	180	9.5 - 25.0	12WSB01	57-58
		Di-n-butyl phthalate	3,400	9.5 - 25.5	12CWS01	57-58
		Fluorene	5,400	9.5 - 25.0	12WSB01	57-58
		Fluoranthene	28,000	9.5 - 25.0	12WSB01	57-58
		Hexachloroethane	150	9.5 - 25.0	12WSB01	57-58
		Indeno(1,2,3-cd)pyrene	4,800	9.5 - 25.0	12WSB01	57-58
		Naphthalene	1,200	9.5 - 25.0	12WSB01	57-58
		N-nitrosodiphenylamine	590	34.5 - 35.0	12SSB01	57-58
		Phenanthrene	34,000	9.5 - 25.0	12WSB01	57-58
		1,2-Dichlorobenzene	2,800	9.5 - 25.5	12CWS01	57-58
		1,4-Dichlorobenzene	1,400	9.5 - 25.5	12CWS01	57-58
		2,4-Dinitrotoluene	200	9.5 - 25.0	12WSB01	57-58
		2,6-Dinitrotoluene	420	9.5 - 25.5	12CWS01	57-58
		Soil Results:				
CS 13	19	Acetone	76,000	10.5 - 11.0	13WSB02	63-64
		Chlorobenzene	22	8.0 - 14.0	13CWS02	63-64
		Methylene chloride	150	10.5 - 11.0	13WSB02	63-64
		Ethylbenzene	2,500	8.0 - 14.0	13CWS02	63-64
		Styrene	15	8.5 - 10.0	13WSB02	63-64

TABLE 2-4. (Continued)

Site	IC	Contaminant	Maximum Concentration (μg/kg)	Sample Depth (ft BGS)	Boring Number	McLaren, 1986 Report Page Number
CS 13 (Continued)						
		Toluene	1,100	8.5 - 10.0	13WSB02	63-64
		Total xylenes	1,500	8.0 - 14.0	13CWS02	63-64
		2-Butanone	43,000	8.5 - 10.0	13WSB02	63-64
		2-Hexanone	4,900	10.5 - 11.0	13WSB02	63-64
		trans-1,2-Dichloroethylene	98	6.5 - 7.0	13CWS01	63-64
		Benzoic acid	200	9.5 - 10.0	13WSB03	63-64
		Phenol	220	8.5 - 10.0	13WSB02	63-64
		Pentachlorophenol	340	9.5 - 10.0	13WSB03	63-64
		2-Methyl naphthalene	250	8.5 - 10.0	13WSB02	63-64
		2-Methylphenol	350	8.5 - 10.0	13WSB02	63-64
		2,4-Dimethylphenol	400	8.5 - 10.0	13WSB02	63-64
		4-Chloroaniline	270	9.5 - 10.0	13WSB03	63-64
		4-Methylphenol	950	8.5 - 10.0	13WSB02	63-64
		PCB Aroclor 1260	1,800	8 - 14	13CWS02	63-64
		Chlordane	720	6.5 - 7.0	13CWS01	63-64
		Grease and oil (mg/kg)	7,500	8.0 - 14.0	13CWS02	63-64
		Acenaphthene	100	9.5 - 10.0	13WSB03	63-64
		bis(2-ethylhexyl)phthalate	2,400	8.5 - 10.0	13WSB02	63-64
		Chrysene	170	9.5 - 10.0	13WSB03	63-64
		Diethyl phthalate	170	9.5 - 10.0	13WSB03	63-64
		Di-n-butyl phthalate	420	9.5 - 10.0	13WSB03	63-64
		Fluoranthene	160	8.5 - 10.0	13WSB02	63-64
		Naphthalene	310	9.5 - 10.0	13WSB03	63-64
		N-nitrosodiphenylamine	22,000	8.0 - 14.0	13CWS02	63-64
		N-nitrosodi-n-propylamine	950	8.5 - 10.0	13WSB02	63-64
		Phenanthrene	190	8.5 - 10.0	13WSB02	63-64
		Pyrene	150	9.5 - 10.0	13WSB03	63-64
		1,2-Dichlorobenzene	360	8.5 - 10.0	13WSB02	63-64
		1,4-Dichlorobenzene	120	8.5 - 10.0	13WSB02	63-64
		2,6-Dinitrotoluene	1,700	9.5 - 10.0	13WSB03	63-64
		Soil Results:				
CS 14	19	Chlorobenzene	46	9.5 - 20.5	14WSB02	68-69
		Chloroform	51	30.0 - 30.5	14CWS01	68-69

TABLE 2-4. (Continued)

Site	IC	Contaminant	Maximum Concentration (µg/kg)	Sample Depth (ft BGS)	Boring Number	McLaren, 1986 Report Page Number
CS 14 (Continued)						
		Methylene chloride	140	31.0 - 31.5	14WSB01	68-69
		Styrene	23	16.5 - 30.5	14WSB01	68-69
		Toluene	43	9.5 - 20.5	14WSB02	68-69
		Total xylenes	250	9.5 - 20.5	14WSB02	68-69
		2-Butanone	120	16.5 - 30.5	14WSB01	68-69
		Benzyl alcohol	100	16.5 - 30.5	14WSB01	68-69
		Phenol	130	16.5 - 30.5	14WSB01	68-69
		2-Methyl naphthalene	180	16.5 - 30.5	14WSB01	68-69
		Dibenzofuran	230	16.5 - 30.5	14WSB01	68-69
		Grease and oil (mg/kg)	4,100	9.5 - 20.5	14WSB02	68-69
		Acenaphthene	210	16.5 - 30.5	14WSB01	68-69
		Anthracene	150	16.5 - 30.5	14WSB01	68-69
		bis(2-ethylhexyl)phthalate	11,000	9.5 - 20.5	14WSB02	68-69
		Butyl benzyl phthalate	370	9.5 - 20.5	14WSB02	68-69
		Diethyl phthalate	300	9.5 - 20.5	14WSB02	68-69
		Dimethyl phthalate	880	16.5 - 30.5	14WSB01	68-69
		Di-n-butyl phthalate	1,300	9.5 - 20.5	14WSB02	68-69
		Di-n-octyl phthalate	160	9.5 - 20.5	14WSB02	68-69
		Fluorene	300	16.5 - 30.5	14WSB01	68-69
		Fluoranthene	430	16.5 - 30.5	14WSB01	68-69
		Naphthalene	220	9.5 - 20.5	14WSB02	68-69
		N-nitrosodiphenylamine	1,400	39.0 - 39.5	14SSB03	68-69
		Phenanthrene	1,300	16.5 - 30.5	14WSB01	68-69
		Pyrene	240	16.5 - 30.5	14WSB01	68-69
		1,2-Dichlorobenzene	840	9.5 - 20.5	14WSB02	68-69
		1,4-Dichlorobenzene	610	9.5 - 20.5	14WSB02	68-69
		2,6-Dinitrotoluene	100	16.5 - 30.5	14WSB01	68-69
PRL 15	17	(No Results)				
PRL 16	17	(No Results)				
PRL 17	14	(No Results)				
PRL 18	13	(No Results)				
PRL 19	13	(No Results)				

TABLE 2-4. (Continued)

Site	IC	Contaminant	Maximum Concentration (μg/kg)	Sample Depth (ft BGS)	Boring Number	McLaren, 1986 Report Page Number
		Soil Results:				
PRL 20	14	Methylene chloride	260	31 - 31.5	20WSB01	74-75
PRL 21	14	Benzene	53	31 - 31.5	21WSB01	Appendix 2
		Methylene chloride	18	31 - 31.5	21WSB01	Appendix 2
		Toluene	21	31 - 31.5	21WSB01	Appendix 2
		Soil Gas Results:				
CS 22[a]	14	Freon 12	3,800	90	SB10-J	*
		Freon 113	14,000	61	SB12-J	*
		Vinyl Chloride	330,000	27.5	SB03-J	*
		1,1-Dichloroethene	39,000	27.5	SB16-J	*
		cis-1,2-Dichloroethene	910,000	40	SB16-J	*
		trans-1,2-Dichloroethene	230,000	80	SB02-J	*
		1,1,1-Trichloroethane	2,700	29	SB12-J	*
		Trichloroethene	920,000	40	SB16-J	*
		Tetrachloroethene	260,000	95	SB13-J	*
		Benzene	100,000	70	SB04-J	*
		Toluene	230,000	91	SB11-J	*
		m,p-xylene	56,000	61	SB11-J	*
		o-xylene	19,000	61	SB11-J	*
		Soil Results:				
		Acetone	1,100	5.0 - 26.0	22CWS01	81-82
		Benzene	420	51.25	SB11-J	*
		Chlorobenzene	6,600	5.0 - 26.0	22CWS01	81-82
		Chloroform	41	30.0 - 30.5	22WSB01	81-82
		Methylene chloride	88	79.5 - 80.0	22SSB02	81-82
		Ethylbenzene	8,800	51.25	SB11-J	*
		Methyl Ethyl ketone	1,000	50.75	SB12-A	*
		Methyl Isobutyl ketone	3,200	61.25	SB11-J	*
		Methylene Chloride	2	91.5	SB05-J	*
		cis-1,2-Dichloroethene	640	61.25	SB11-J	*
		Toluene	13,000	61.25	SB11-J	*
		Total xylenes	15,000	61.25	SB11-J	*
		Tetrachloroethylene	48	64.0 - 64.5	22SSB02	81-82
		Trichloroethylene	28,000	29.0 - 29.5	22CWS01	81-82

TABLE 2-4. (Continued)

Site	IC	Contaminant	Maximum Concentration ($\mu g/kg$)	Sample Depth (ft BGS)	Boring Number	McLaren, 1986 Report Page Number
CS 22 (Continued)						
		2-Butanone	6,300	5.0 - 26.0	22CWS01	81-82
		2-Hexanone	13,000	59.5 - 60.0	22SSB03	81-82
		4-Methyl-2-pentanone	1,800	5.0 - 26.0	22CWS01	81-82
		Benzoic acid	69,000	5.0 - 26.0	22CWS01	81-82
		Phenol	1,400	44.0 - 44.5	22CWS01	81-82
		2-Methyl naphthalene	13,000	59.5 - 60.0	22SSB03	81-82
		2-Methylphenol	1,700	44.0 - 44.5	22CWS01	81-82
		2,4-Dimethylphenol	2,300	44.0 - 44.5	22CWS01	81-82
		4-Methylphenol	4,200	44.0 - 44.5	22CWS01	81-82
		PCB Aroclor 1260	1,000	5.0 - 26.0	22CWS01	81-82
		Grease and oil (mg/kg)	27,000	5.0 - 26.0	22CWS01	81-82
		Acenaphthene	340	5.5 - 18.5	22WSB03	81-82
		Anthracene	760	5.5 - 18.5	22WSB03	81-82
		Benzo(a)anthracene	2,000	5.5 - 18.5	22WSB03	81-82
		Benzo(a)pyrene	1,400	5.5 - 18.5	22WSB03	81-82
		Benzo(g,h,i)perylene	1,100	5.5 - 18.5	22WSB03	81-82
		Benzo(k)fluoranthene	2,000	5.5 - 18.5	22WSB03	81-82
		bis(2-ethylhexyl)phthalate	6,000	5.5 - 18.5	22WSB03	81-82
		Butyl benzyl phthalate	220	5.5 - 18.5	22WSB03	81-82
		Chrysene	1,700	5.5 - 18.5	22WSB03	81-82
		Dibenzo(a,h)anthracene	270	5.5 - 18.5	22WSB03	81-82
		Diethyl phthalate	380	5.5 - 18.5	22WSB03	81-82
		Dimethyl phthalate	120	5.5 - 18.5	22WSB03	81-82
		Di-n-butyl phthalate	550	5.5 - 18.5	22WSB03	81-82
		Di-n-octyl phthalate	140	59.0 - 59.5	22SSB01	81-82
		Fluorene	510	5.5 - 18.5	22WSB03	81-82
		Fluoranthene	3,800	5.5 - 18.5	22WSB03	81-82
		Indeno(1,2,3-cd)pyrene	1,300	5.5 - 18.5	22WSB03	81-82
		Naphthalene	5,800	21.25	SB03-J	*
		Nitrobenzene	620	59.5 - 60.0	22SSB03	81-82
		N-nitrosodiphenylamine	1,600	64.0 - 64.5	22SSB02	81-82
		Phenanthrene	3,200	5.5 - 18.5	22WSB03	81-82
		Pyrene	2,900	5.5 - 18.5	22WSB03	81-82

TABLE 2-4. (Continued)

Site	IC	Contaminant	Maximum Concentration (µg/kg)	Sample Depth (ft BGS)	Boring Number	McLaren, 1986 Report Page Number
CS 22 (Continued)						
		1,2-Dichlorobenzene	59,000	17.25	SB05-J	*
		1,4-Dichlorobenzene	42,000	17.25	SB05-J	*
		3,4-Benzofluoranthene	1,100	5.5 - 18.5	22WSB03	81-82
		p,p'-DDD	160	17.5	SB05-J	*
		p,p'-DDE	58	16	SB06-J	*
		p,p'-DDT	162	1.25	SB15-J	*
		Arochlor 1260	2,100	1.0	SB01-J	*
		BHC Gamma	4.4	16.25	SB03-J	*
		2,3,7,8-tetrachlorodibenzo-p-dioxin	2,600	17.75	SB06-J	*
		tetrachlorodibenzo-p-dioxin	2,600	17.75	SB06-J	*
		pentachlorodibenzo-p-dioxin	7,700	10.0	SB06-J	*
		hexachlorodibenzo-p-dioxin	29,000	10.0	SB06-J	*
		octachlorodibenzo-p-dioxin	33,000	10.0	SB06-J	*
		2,3,7,8-tetrachlorodibenzo-furan	3,000	17.75	SB06-J	*
		tetrachlorodibenzofuran	3,000	17.75	SB06-J	*
		pentachlorodibenzofuran	2,700	6.25	SB14-J	*
		hexachlorodibenzofuran	1,800	6.25	SB14-J	*
		heptachlorodibenzofuran	2,760	25	SB14-J	*
		octachlorodibenzofuran	2,000	10.0	SB06-J	*
		Soil Results:				
PRL 28	15	Toluene	22	64.5 - 65.0	28SSB02	86
		bis(2-ethylhexyl)phthalate	310	69.0 - 69.5	28SSB03	86
		Di-n-butyl phthalate	180	69.0 - 69.5	28SSB03	86
		Soil Results:				
PRL 32	11	Acetone	550	8.5 - 9.0	32SSB02	87
		Grease and oil (mg/kg)	440	24.0 - 24.5	32WSB01	87
		bis(2-ethylhexyl)phthalate	940	24.0 - 24.5	32WSB01	87
		N-nitrosodiphenylamine	180	24.0 - 24.5	32WSB01	87
		Soil Gas Results:				
PRL 41[a]	14	Freon 12	570	17.5	SB09-J	*
		Freon 113	960	17.5	SB10-J	*

TABLE 2-4. (Continued)

Site	IC	Contaminant	Maximum Concentration (μg/kg)	Sample Depth (ft BGS)	Boring Number	McLaren, 1986 Report Page Number
PRL 41 (Continued)						
		Vinyl Chloride	7,000	71	SB07-J	*
		1,1-Dichloroethene	460	2.5	SB01-J	*
		cis-1,2-Dichloroethene	3,000	71	SB07-J	*
		trans-1,2-Dichloroethene	3,900	80	SB05-J	*
		1,1,1-Trichloroethane	19	7.5	SB01-J	*
		Trichloroethene	78,000	80	SB08-J	*
		Tetrachloroethene	280	2.5	SB07-J	*
		Benzene	40,000	80	SB08-J	*
		Toluene	4,900	80	SB05-J	*
		m,p-xylene	8,700	80	SB05-J	*
		o-xylene	1,300	80	SB05-J	*
		Soil Results:				
		Acetone	1,900	19.5 - 20.0	41CWS01	92
		Chloroform	12	19.5 - 20.0	41CWS01	92
		Tetrachloroethylene	18	79.5 - 80.0	41SSB01	92
		Trichloroethene	49	94.0	SB08-J	*
		2-Butanone	390	3.0 - 3.5	41WSB02	92
		Grease and oil (mg/kg)	840	14.5 - 15.5	41CWS01	92
		bis(2-ethylhexyl)phthalate	1,600	14.5 - 15.5	41CWS01	92
		Di-n-butyl phthalate	460	49.0 - 49.5	41SSB01	92
		N-nitrosodiphenylamine	220	2.0 - 2.5	41WSB01	92
		1,2-Dichlorobenzene	1,300	15.75	SB03-J	*
		1,4-Dichlorobenzene	410	14.5 - 15.5	41CWS01	92
		p,p'-DDD	3.6	0.5	SB04-J	*
		p,p'-DDE	57	0.5	SB10-J	*
		p,p'-DDT	17	0.5	SB10-J	*
		Arochlor 1260	54	15.75	SB03-J	*
		Hexachlorodibenzo-p-dioxin	1,200	12.75	SB02-J	*
		Heptachlorodibenzo-p-dioxin	4,400	12.75	SB02-J	*
		Octachlorodibenzo-p-dioxin	8,000	12.75	SB02-J	*
		Pentachlorodibenzofuran	400	12.75	SB02-J	*
		Hexachlorodibenzofuran	400	12.75	SB02-J	*
		Heptachlorodibenzofuran	800	12.75	SB02-J	*

TABLE 2-4. (Continued)

Site	IC	Contaminant	Maximum Concentration (µg/kg)	Sample Depth (ft BGS)	Boring Number	McLaren, 1986 Report Page Number
PRL 41 (Continued)						
		Octachlorodibenzofuran	700	12.75	SB02-J	*
		Soil Gas Results:				
CS 42[a]	14	Freon 12	1,200	71	SB04-B	*
		Freon 113	15,000,000	40	SB14-J	*
		Vinyl Chloride	3,800,000	40	SB14-J	*
		1,1-Dichloroethene	220,000	90	SB15-J	*
		cis-1,2-Dichloroethene	21,000,000	40	SB14-J	*
		trans-1,2-Dichloroethene	88,000	60	SB07-J	*
		1,1,1-Trichloroethane	300,000	40	SB12-J	*
		Trichloroethene	6,600,000	50	SB14-J	*
		Tetrachloroethene	640,000	90	SB16-J	*
		Soil Results:				
		Benzene	5,500	91	SB08-J	*
		Toluene	3,100,000	27.5	SB05-J	*
		m,p-xylene	130,000	80	SB03-J	*
		o-xylene	13,000	60	SB06-J	*
		Benzene	120	61.0	SB02-J	*
		Chlorobenzene	2,100	39.5 - 40.0	42SSB03	98-100
		Chloroform	340	39.5 - 40.0	42SSB03	98-100
		Ethylbenzene	12,000	51.0	SB15-J	*
		Styrene	460	2.0 - 8.5	42CWS01	98-100
		Toluene	9,900	51.0	SB15-J	*
		Total xylenes	76,000	51.0	SB15-J	*
		Acetone	93,000	51.0	SB15-J	*
		Methylene chloride	2,500	71.5	SB15-J	*
		cis-1,2-Dichloroethene	130	61.0	SB02-J	*
		Tetrachloroethylene	2,500	14.5 - 15.0	42WSB02	98-100
		Trichloroethylene	490,000	51.0	SB15-J	*
		1,1-Dichloroethane	46	39.5 - 40.0	42SSB03	98-100
		1,1,1-Trichloroethane	83	81.0 - 81.5	42CWS01	98-100
		1,2-Dichloroethane	17,000	51.0	SB15-J	*
		1,3-Dichloropropylene	52	14.5 - 15.0	42WSB02	98-100
		2-Butanone	400	49.5 - 50.0	42WSB02	98-100

TABLE 2-4. (Continued)

Site	IC	Contaminant	Maximum Concentration (μg/kg)	Sample Depth (ft BGS)	Boring Number	McLaren, 1986 Report Page Number
CS 42 (Continued)						
		2-Hexanone	3,500	39.5 - 40.0	42SSB03	98-100
		4-Methyl-2-pentanone	6,400	39.5 - 40.0	42SSB03	98-100
		trans-1,2-Dichloroethylene	3,400	14.5 - 15.0	42WSB02	98-100
		1,2-Dichloropropane	1,800	14.5 - 15.0	42WSB02	98-100
		Dichlorobromomethane	27	39.5 - 40.0	42SSB03	98-100
		Benzoic acid	1,000	39.5 - 40.0	42SSB03	98-100
		Phenol	15,000	28.25	SB05-J	*
		2-Methyl naphthalene	13,000	39.5 - 40.0	42SSB03	98-100
		2-Methylphenol	540	39.5 - 40.0	42SSB03	98-100
		2,4-Dimethylphenol	710,000	31.5	SB11-J	*
		4-Chloroaniline	120	49.0 - 49.5	42SSB01	98-100
		4-Methylphenol	100,000	28.25	SB05-J	*
		Dibenzofuran	1,200	49.0 - 49.5	42SSB01	98-100
		Grease and oil (mg/kg)	9,600	3.0 - 11.0	42WSB02	98-100
		PCB Aroclor 1254	1,200	3.0 - 11.0	42WSB02	98-100
		Acenaphthylene	150	39.5 - 40.0	42SSB03	98-100
		bis(2-ethylhexyl)phthalate	7,500	2.0 - 8.5	42CWS01	98-100
		Di-n-butyl phthalate	750	39.5 - 40.0	42SSB03	98-100
		Fluorene	560	39.5 - 40.0	42SSB03	98-100
		Naphthalene	12,000	20.25	SB07-J	*
		N-nitrosodiphenylamine	280	34.5 - 35.0	42SSB04	98-100
		Phenanthrene	520	39.5 - 40.0	42SSB03	98-100
		1,2-Dichlorobenzene	460,000	20.75	SB05-J	*
		1,4-Dichlorobenzene	1,400	20.75	SB05-J	*
		2,6-Dinitrotoluene	690	39.5 - 40.0	42SSB03	98-100
		p,p'-DDD	630	20.5	SB05-J	*
		p,p'-DDE	1.7	0.25	SB08-J	*
		p,p'-DDT	28	0.5	SB04-J	*
		Arochlor 1260	870	24	SB16-J	*
		Soil Results:				
CS 43	17	Acetone	510	39.5 - 40.0	43SSB02	106-107
		Benzene	78	20.5 - 21.0	43WSB01	106-107
		Chlorobenzene	7,900	7.0 - 21.0	43CWS02	106-107

TABLE 2-4. (Continued)

Site	IC	Contaminant	Maximum Concentration (μg/kg)	Sample Depth (ft BGS)	Boring Number	McLaren, 1986 Report Page Number
CS 43 (Continued)						
		Chloroform	29	10.0 - 14.5	43WSB02	106-107
		Methylene chloride	160	39.5 - 40.0	43SSB02	106-107
		Ethylbenzene	490	10.0 - 14.5	43WSB02	106-107
		Toluene	520	7.0 - 21.0	43CWS02	106-107
		Total xylenes	2,300	7.0 - 21.0	43CWS02	106-107
		2-Hexanone	130	10.0 - 14.5	43WSB02	106-107
		2-Chloroethylvinyl ether	23	10.0 - 14.5	43WSB02	106-107
		4-Methyl-2-pentanone	880	10.0 - 14.5	43WSB02	106-107
		Benzoic acid	48,000	7.0 - 21.0	43CWS02	106-107
		Benzyl alcohol	330	7.0 - 21.0	43CWS02	106-107
		2-Methyl naphthalene	3,800	7.0 - 21.0	43CWS02	106-107
		2-Methylphenol	4,500	7.0 - 21.0	43CWS02	106-107
		2,4-Dimethylphenol	11,000	5.5 - 19.5	43WSB01	106-107
		4-Chloroaniline	7,200	7.0 - 21.0	43CWS02	106-107
		4-Methylphenol	2,600	5.5 - 19.5	43WSB01	106-107
		Dibenzofuran	510	7.0 - 21.0	43CWS02	106-107
		Grease and oil (mg/kg)	17,000	7.0 - 21.0	43CWS02	106-107
		PCB Aroclor 1254	4,600	7.0 - 21.0	43CWS02	106-107
		Acenaphthene	370	7.0 - 21.0	43CWS02	106-107
		Anthracene	460	5.5 - 19.5	43WSB01	106-107
		Benzo(a)anthracene	1,100	5.5 - 19.5	43WSB01	106-107
		Benzo(a)pyrene	430	44.5 - 45.0	43CWS02	106-107
		bis(2-ethylhexyl)phthalate	51,000	7.0 - 21.0	43CWS02	106-107
		Butyl benzyl phthalate	490	10.0 - 14.5	43WSB02	106-107
		Chrysene	1,500	5.5 - 19.5	43WSB01	106-107
		Diethyl phthalate	4,600	7.0 - 21.0	43CWS02	106-107
		Dimethyl phthalate	140	10.0 - 14.5	43WSB02	106-107
		Di-n-butyl phthalate	2,700	7.0 - 21.0	43CWS02	106-107
		Fluorene	960	7.0 - 21.0	43CWS02	106-107
		Fluoranthene	340	7.0 - 21.0	43CWS02	106-107
		Naphthalene	6,100	7.0 - 21.0	43CWS02	106-107
		Nitrobenzene	750	7.0 - 21.0	43CWS02	106-107

TABLE 2-4. (Continued)

Site	IC	Contaminant	Maximum Concentration (μg/kg)	Sample Depth (ft BGS)	Boring Number	McLaren, 1986 Report Page Number
CS 43 (Continued)						
		N-nitrosodiphenylamine	1,100	7.0 - 21.0	43CWS02	106-107
		Phenanthrene	1,800	5.5 - 19.5	43WSB01	106-107
		1,2-Dichlorobenzene	20,000	7.0 - 21.0	43CWS02	106-107
		1,3-Dichlorobenzene	2,400	5.5 - 19.5	43WSB01	106-107
		1,4-Dichlorobenzene	11,000	7.0 - 21.0	43CWS02	106-107
		1,2,4-Trichlorobenzene	1,900	7.0 - 21.0	43CWS02	106-107
		2,4-Dinitrotoluene	1,000	7.0 - 21.0	43CWS02	106-107
		3,3-Dichlorobenzidine	190	5.5 - 19.5	43WSB01	106-107
PRL 49	18	(No Results)				
PRL 50	16	(No Results)				
PRL 51	16	(No Results)				
		Soil Results:				
CS 52	17	Dibenzofuran	500	9.0 - 11.0	52WSB01	116
		2-Methyl naphthalene	250	9.0 - 11.0	52WSB01	116
		4,4'-DDD	410	9.0 - 11.0	52WSB01	116
		4,4'-DDE	150	9.0 - 11.0	52WSB01	116
		Acenaphthene	970	9.0 - 11.0	52WSB01	116
		Anthracene	1,200	9.0 - 11.0	52WSB01	116
		Benzo(a)anthracene	7,600	9.0 - 11.0	52WSB01	116
		Benzo(a)pyrene	13,000	9.0 - 11.0	52WSB01	116
		Benzo(g,h,i)perylene	8,700	9.0 - 11.0	52WSB01	116
		Benzo(k)fluoranthene	14,000	9.0 - 11.0	[illegible]WSB01	116
		bis(2-ethylhexyl)phthalate	470	9.0 - 11.0	52WSB01	116
		Chrysene	6,200	9.0 - 11.0	52WSB01	116
		Dibenzo(a,h)anthracene	3,500	9.0 - 11.0	52WSB01	116
		Fluorene	670	9.0 - 11.0	52WSB01	116
		Fluoranthene	4,100	9.0 - 11.0	52WSB01	116
		Indeno(1,2,3-cd)pyrene	11,000	9.0 - 11.0	52WSB01	116
		Naphthalene	2,300	9.0 - 11.0	52WSB01	116
		Phenanthrene	4,200	9.0 - 11.0	52WSB01	116
		Pyrene	10,000	9.0 - 11.0	52WSB01	116
		3,4-Benzofluoranthene	14,000	9.0 - 11.0	52WSB01	116

TABLE 2-4. (Continued)

Site	IC	Contaminant	Maximum Concentration (μg/kg)	Sample Depth (ft BGS)	Boring Number	McLaren, 1986 Report Page Number
PRL 53	N/A	Trichloroethene	200	—	—	**
PRL 54	13	(No Results)				
		Soil Results:				
PRL 55	13	Toluene	630	79.5 - 80.0	55WSB01	121
		Trichloroethylene	380	79.5 - 80.0	55WSB01	121
		trans-1,2-Dichloroethylene	1,300	79.5 - 80.0	55WSB01	121
		1,1-Dichloroethylene	4,100	79.5 - 80.0	55WSB01	121
		1,1-Dichloroethane	720	79.5 - 80.0	55WSB01	121
		1,1,1-Trichloroethane	430	79.5 - 80.0	55WSB01	121
		4-Methyl-2-pentanone	1,000	79.5 - 80.0	55WSB01	121
PRL 56	11	(No Results)				
PRL 57	11	(No Results)				
PRL 60	15	(No Results)				
PRL 63	14	(No Results)				
PRL 64	14	(No Results)				
PRL 65	9	(No Results)				
PRL 66	12, 14, 18, 20	(No Results)				
		Soil Results:				
CS 67	17	Benzene	110	1.5 - 7.5	67WSB01	140
		Chlorobenzene	3,100	1.5 - 7.5	67WSB01	140
		Ethylbenzene	220	1.5 - 7.5	67WSB01	140
		Toluene	630	1.5 - 7.5	67WSB01	140
		Total xylenes	840	1.5 - 7.5	67WSB01	140
		Trichloroethylene	1,600	3.0 - 4.5	67WSB03	140
		1,2-Dichloroethane	870	1.5 - 7.5	67WSB01	140
		trans-1,2-Dichloroethylene	3,000	1.5 - 7.5	67WSB01	140
		Vinyl chloride	1,800	1.5 - 7.5	67WSB01	140
		2-Methyl naphthalene	3,200	1.5 - 7.5	67WSB01	140
		2-Methylphenol	4,100	1.5 - 7.5	67WSB01	140
		2,4-Dimethylphenol	9,500	1.5 - 7.5	67WSB01	140
		4-Methylphenol	5,100	1.5 - 7.5	67WSB01	140

TABLE 2-4. (Continued)

Site	IC	Contaminant	Maximum Concentration (μg/kg)	Sample Depth (ft BGS)	Boring Number	McLaren, 1986 Report Page Number
CS 67 (Continued)						
		Di-n-butyl phthalate	1,900	1.5 - 7.5	67WSB01	140
		Indeno(1,2,3-cd)pyrene	310	2.0 - 7.5	67CWS01	140
		Naphthalene	4,000	1.5 - 7.5	67WSB01	140
		Phenanthrene	1,300	1.5 - 7.5	67WSB01	140
		Pyrene	1,000	1.5 - 7.5	67WSB01	140
		1,2-Dichlorobenzene	21,000	1.5 - 7.5	67WSB01	140
		1,3-Dichlorobenzene	890	1.5 - 7.5	67WSB01	140
		1,4-Dichlorobenzene	4,400	1.5 - 7.5	67WSB01	140
		1,2,4-Trichlorobenzene	1,900	1.5 - 7.5	67WSB01	140
		Soil Gas Results:				
PRL 68[a]	14	Freon 12	2,800	7.5	SB03-J	*
		Freon 113	10	7.5	SB04-J	*
		Vinyl Chloride	13,000	27.5 and 40	SB01-J	*
		1,1-Dichloroethene	5,300	70	SB05-J	*
		cis-1,2-Dichloroethene	120,000	80	SB05-J	*
		trans-1,2-Dichloroethene	2,200	60 and 90	SB03-J	*
		1,1,1-Trichloroethane	1,700	7.5	SB03-J	*
		Trichloroethene	2,100,000	90	SB04-J	*
		Tetrachloroethene	86,000	90	SB02/04-J	*
		Toluene	3,000	90	SB03-J	*
		m,p-xylene	4,500	60	SB01-J	*
		o-xylene	800,000	90	SB04-J	*
		Soil Results:				
		Chlorobenzene	210	4.0 - 4.5	68WSB02	143
		Total xylenes	400	4.0 - 4.5	68WSB02	143
		Trichloroethylene	1,800	72.25	SB01-J	*
		cis-1,2-Dichloroethene	130	72.25	SB01-J	*
		1,2-Dichloroethane	640	71.5 - 72.0	68WSB02	143
		2-Methyl naphthalene	320	4.0 - 4.5	68WSB02	143
		4,4'-DDD	14	4.0 - 4.5	68WSB02	143
		4,4'-DDE	5	4.0 - 4.5	68WSB02	143
		Hydrocarbons (ppm)	230	4.0 - 4.5	68WSB02	143

TABLE 2-4. (Continued)

Site	IC	Contaminant	Maximum Concentration (µg/kg)	Sample Depth (ft BGS)	Boring Number	McLaren, 1986 Report Page Number
PRL 68 (Continued)						
		bis(2-ethylhexyl)phthalate	2,600	4.0 - 4.5	68WSB02	143
		Naphthalene	610	4.0 - 4.5	68WSB02	143
		1,2-Dichlorobenzene	1,500	4.0 - 4.5	68WSB02	143
		1,4-Dichlorobenzene	210	4.0 - 4.5	68WSB02	143
		p,p'-DDE	1.5	0.75	SB05-J	*
		Arochlor 1260	88	0.75	SB05-J	*
		Soil Gas Results:				
CS 69*	14	Freon 12	220	60	SB01-J	*
		Freon 113	190	27.5	SB15-B	*
		Vinyl Chloride	13,000	18.5	SB11-J	*
		1,1-Dichloroethene	4,400	7.5	SB06-J	*
		cis-1,2-Dichloroethene	10,000	7.5	SB06-J	*
		trans-1,2-Dichloroethene	5,200	90	SB05-J	*
		1,1,1-Trichloroethane	2,000	7.5	SB13-J	*
		Trichloroethene	10,000	70	SB01-J	*
		Tetrachloroethene	1,200	7.5	SB02-J	*
		Soil Results:				
		Benzene	590	18.5	SB11-J	*
		Toluene	770	18.5	SB11-J	*
		m,p-xylene	5,900	18.5	SB11-J	*
		o-xylene	1,900	18.5	SB11-J	*
		Benzene	110	6.5 - 15.5	69CWS01	147
		Chlorobenzene	6,100	6.5 - 15.5	69CWS01	147
		Ethylbenzene	340	6.5 - 15.5	69CWS01	147
		Toluene	480	13.0 - 18.0	69CWS02	147
		Total xylenes	1,700	6.5 - 15.5	69CWS01	147
		Trichloroethylene	440	6.5 - 15.5	69CWS01	147
		trans-1,2-Dichloroethylene	370	13.0 - 18.0	69CWS02	147
		Vinyl chloride	850	6:5 - 15.5	69CWS01	147
		Phenol	870	6.5 - 15.5	69CWS01	147
		2-Methyl naphthalene	1,700	6.5 - 15.5	69CWS01	147
		2-Methylphenol	1,200	6.5 - 15.5	69CWS01	147

TABLE 2-4. (Continued)

Site	IC	Contaminant	Maximum Concentration (µg/kg)	Sample Depth (ft BGS)	Boring Number	McLaren, 1986 Report Page Number
CS 69 (Continued)						
		2,4-Dimethylphenol	2,900	6.5 - 15.5	69CWS01	147
		4-Methylphenol	2,300	6.5 - 15.5	69CWS01	147
		Hydrocarbons (ppm)	65	6.5 - 15.5	69CWS01	147
		bis(2-ethylhexyl)phthalate	2,700	6.5 - 15.5	69CWS01	147
		Diethyl phthalate	140	13.0 - 18.0	69CWS02	147
		Di-n-butyl phthalate	470	13.0 - 18.0	69CWS02	147
		Fluoranthene	150	13.0 - 18.0	69CWS02	147
		Naphthalene	1,700	6.5 - 15.5	69CWS01	147
		Phenanthrene	200	13.0 - 18.0	69CWS02	147
		Pyrene	250	13.0 - 18.0	69CWS02	147
		1,2-Dichlorobenzene	8,700	6.5 - 15.5	69CWS01	147
		1,3-Dichlorobenzene	620	6.5 - 15.5	69CWS01	147
		1,4-Dichlorobenzene	6,000	6.5 - 15.5	69CWS01	147
		p,p'-DDD	110	13.25	SB12-J	*
		p,p'-DDE	2.6	0.75	SB13-J	*
		p,p'-DDT	15	0.75	SB13-J	*
		hexachlorodibenzo-p-dioxin	1,800	13.0	SB02-J	*
		heptachlorodibenzo-p-dioxin	20,000	12.5	SB07-J	*
		octachlorodibenzo-p-dioxin	16,000	13.0	SB02-J	*
		hexachlorodibenzofuran	700	12.5	SB07-J	*
		heptachlorodibenzofuran	4,900	12.5	SB07-J	*
		octachlorodibenzofuran	8,200	12.5	SB07-J	*

[a] Site is in OU C1.
* Data from Jacobs Engineering investigation of OU C1 (no report as of this date).
** Data from 1990 sampling by McClellan AFB Environmental Management.

McLaren data from: McLaren, 1986. Technical Memorandum for the Shallow Investigation Program in Areas A, B, C, and Other Sites — Part V — Area C, May, 1986. Prepared for Department of the Air Force — Sacramento Air Logistics Center — McClellan AFB, CA.

3.0 CONCEPTUAL MODELS FOR OPERABLE UNIT (OU) C

Conceptual models provide a framework for the remedial investigation (RI) in which contaminants, sources, migration pathways, exposure routes, and potential receptors can be characterized. The models relate conceptual pictures that summarize site-specific details, identify data gaps, and provide the structure for decision-making. Conceptual models are composed of tables and figures that portray what is currently known about a specific location or a geographic area (such as a location or an Operable Unit), and are based on real data. Details or "data gaps" are added as the investigation proceeds and will presented as addendums to this document and/or in the OU C RI report. The field sampling plans in Section 5 are conceptual models for specific locations within OU C. The conceptual model for OU C, as a whole, is discussed below.

3.1 Contaminant Types and Affected Media

Contaminants have been detected in the environmental media of OU C during previous investigations. *Analyses of subsurface soil and groundwater samples indicate that volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), polycyclic aromatic hydrocarbons (PAHs), pesticides, and inorganic constituents (cyanide, metals) have been discharged to soils from locations formerly used as disposal or burial pits* (CH2M HILL, 1993). Soil gas sampling and analyses indicate that VOCs and methane are present in the vapor phase above former waste disposal pits (Radian, 1988b; CH2M HILL, 1993) and that VOCs are present in soil gas throughout the vadose zone adjacent to OU C1 (Jacobs, 1992b). Petroleum hydrocarbons, SVOCs, VOCs, PAHs, and inorganic constituents have been detected in sediments sampled from stream courses and surface drainages within OU C (Radian, 1990; Radian, 1993). Surface water samples from those same stream courses and drainages yielded detectable concentrations of petroleum hydrocarbons, VOCs, SVOCs, and metals (Radian, 1990). *The greatest concentration of VOCs (68,000 µg/L trichloroethene) in groundwater beneath McClellan Air Force Base (AFB) was detected in samples from Monitoring Well (MW) 128 in OU C* (Radian, 1987). Inorganic constituents at concentrations exceeding Maximum Contaminant Levels (MCLs) have also been reported in groundwater (Radian, 1986–1993).

3.2 Migration Pathways and Potential Receptors

Contaminants detected in OU C pose environmental concerns because of their potential to be released from sources to migration pathways and, via the pathways, to human or ecologic receptors. Primary and secondary sources and release mechanisms, migration pathways, and potential receptors of contaminants in OU C are shown in Figure 3-1. Potential migration pathways that may carry contaminants from OU C to human or ecologic receptors are the atmosphere, workspace (indoor) air, surface soil, surface water, and groundwater are illustrated in Figure 3-2.

The available analytical data indicate that surface water, groundwater, and outdoor air are the only pathways known to be complete in OU C. Migration pathways that are potentially complete now and should be evaluated during the OU C RI include surface soils, workspace air, and the ecological food chain. Migration pathways that are not complete, but could be complete in the future, are residential (indoor) air and homegrown foods.

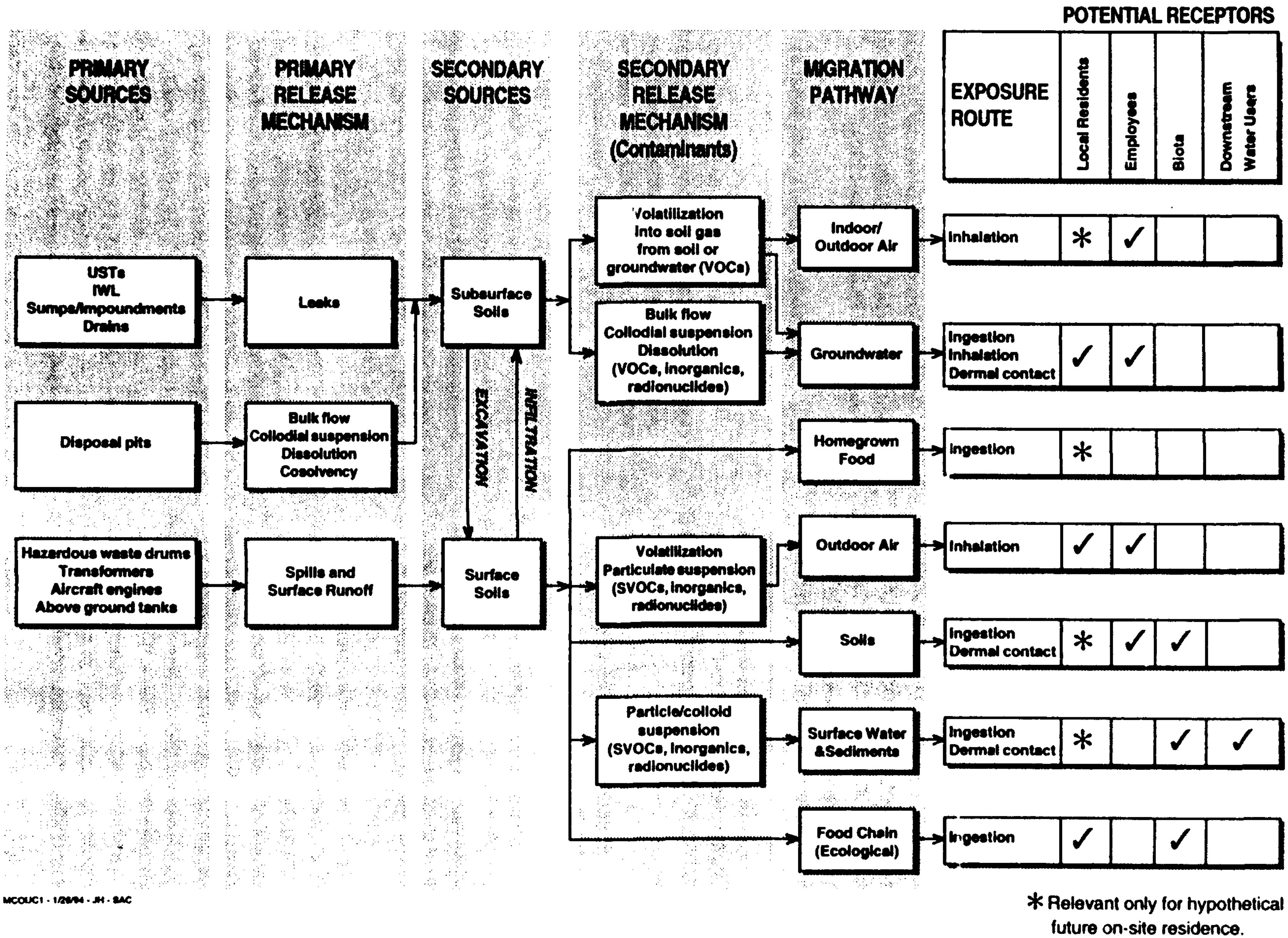

Figure 3-1. Conceptual Framework for Operable Unit C

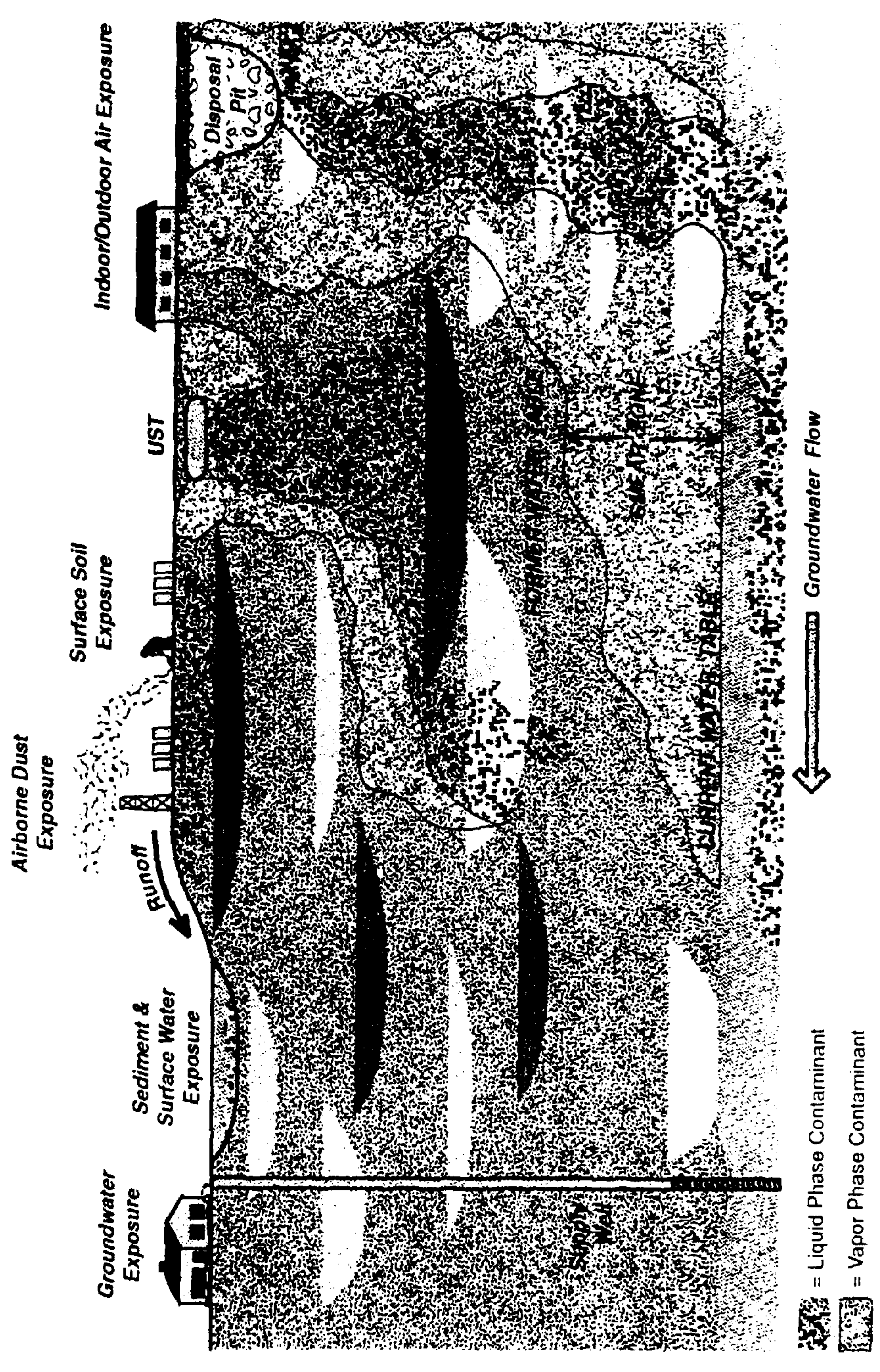

Figure 3-2. Potential Sources, Migration Pathways, and Current Receptor Exposure Routes in OU C

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3.3 Indicated Data Needs

To serve its intended purpose in decision-making, the OU C conceptual model will be completed through the filling of data gaps for each site during the RI. Users and end uses of the conceptual model determine the categories of information that must be compiled to complete the model. Data gaps identified in the model are shown in Table 3-1.

The principal uses of the model will be:

- *To guide or facilitate RI decision-making, including:*
  - *The need for contaminant transport modeling;*
  - *Pathways and receptors to be evaluated in screening and baseline risk assessment;*
  - *Pathways and receptors to be evaluated in ecological risk assessment; and*
  - *Exceedances of regulatory levels (e.g., Applicable or Relevant and Appropriate Requirements) by contaminant concentrations in each medium.*
- *To guide FS decision-making, including:*
  - *Selection of remedial technologies; and*
  - *Development of remedial alternatives that are protective of human health and the environment.*

3.4 Updating Conceptual Models

The conceptual model for each location and for all of OU C will be updated with new data as the RI proceeds. The model will be reassessed periodically to determine if any additional sources, release mechanisms, migration pathways, or receptors should be added. The revised conceptual model will be used to identify data needs to be filled in the next phase of investigation. If there are no additional data needs identified, the model will be complete. Completed models will be the basis of the RI Report, and, if necessary, the FS.

TABLE 3-1. DATA GAPS IN THE OU C CONCEPTUAL MODEL

Model Category	Data Need	Collection Method
Primary/secondary sources	All primary release mechanisms	Physical evidence of wastes or staining; field measurements-Level II; Level III confirmation.
Secondary release mechanisms	Contaminant types and behavior; VOCs in groundwater	Identification through Level III analyses of surface soil, deeper soils, soil gas, and groundwater.
Current or future migration pathways	Soil gas flux to air; soil gas flux to groundwater;	Level III analysis of VOCs; Level II or III analysis of VOCs in deep soil gas; physical parameters of soil for transport modeling.
	Surface soil contaminants;	Level III analysis of surface soils.
	Ecologic food chain	Ecologic receptors and potential predators.
Potential receptors	Transport directions and migration rate	Groundwater elevations; physical parameters; local meteorological data.

4.0 REMEDIAL INVESTIGATION (RI) DECISION PROCESS FOR PHASE I

The Phase I Operable Unit (OU) C decision process provides the framework to develop location-specific data quality objectives (DQOs), characterize risks, and prioritize areas of investigation. The ultimate goal of the decision process for Phase I is to obtain sufficient information to identify source areas and to set priorities for remedial investigation phases or remedial actions (see Figure 1-5 in Section 1).

4.1 Data Quality Objectives

Data quality objectives (DQOs) are qualitative and quantitative statements about the quality, quantity, and type of data needed to make decisions during the remedial investigation/feasibility study (RI/FS). The development of DQOs is a systematic and iterative process to evaluate and identify the data needed (Figure 4-1). *Data quality objectives are developed to:*

- *Promote communication among all parties involved in the RI/FS;*
- *Focus planning for data collection;*
- *Provide structure and organization for complex issues;*
- *Ensure that sufficient data will be collected to meet project objectives; and*
- *Set realistic expectations about data usability and the level of uncertainty associated with missing an area of contamination.*

The outcome of the DQO process must include:

- *A clear statement of the decision(s) to be made;*
- *Detailed specifications about the type, quantity, and quality of data needed to support the decision;*
- *Comparison criteria or processes that will be used to make the decision; and*
- *An estimate of the uncertainty (or confidence) associated with a decision.*

The U.S. Environmental Protection Agency (U.S. EPA) recently revised its guidance on implementing the DQO process to incorporate a more quantitative approach to DQOs through statistical sampling designs (U.S. EPA, 1992; U.S. EPA, 1993a). McClellan AFB has adopted this statistical approach in areas where a clear remediation or no further investigation (NFI) decision cannot be made based on a judgmental sampling design and an estimate of the uncertainty associated with a wrong decision is needed. Phase I sampling designs will be based on best professional judgment, targeting suspected source areas and discharge points. During subsequent phases of the investigation, statistical designs may be used in areas where sufficient data has not been collected to make a remedial decision or to recommend NFI.

4.2 DQO Process for OU C

Data quality objectives were derived for the field sampling and analysis program and for the ensuing data evaluation tasks.

4.2.1 Field DQOs

The primary elements of the DQO process, shown in Figure 4-1, and how they have been implemented in the OU C Field Sampling Plans (FSPs) are discussed below.

Data Quality Objectives Process

State the problem to be resolved

↓

Identify the decision to be made

↓

Identify inputs to the decision

↓

Define the boundaries of the study

↓

Develop a decision rule

↓

Specify uncertainty criteria

↕

OPTIMIZE DESIGN FOR OBTAINING DATA

Figure 4-1. Data Quality Objectives Process

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State the Problem to be Resolved

Chemical substances used, stored, and disposed in OU C may have contaminated the surface and/or subsurface environment.

Identify the Decision to be Made

The first decision is to determine if contaminants have been released at a location and, if so, what concentrations are present and what is the estimated mass of contamination.

Identify Inputs to the Decision

Inputs include the quality, quantity, and type of data that will be sufficient to make decisions. Quality refers to the analytical level of data collected and the necessary detection limit. Quantity refers to the amount of data necessary to make remedial decisions. The type refers to the physical and chemical data needed for each matrix sampled.

Boundaries of the Study

The boundaries are physical limits on sample collection. It is a horizontal and vertical definition of the area under investigation.

Decision Rules

Decision rules are if/then statements phrased to make yes/no decisions. Identifying decision rules early ensures that appropriate analytical methods and detection limits will be selected, and helps determine the number of samples needed. Any ARARs or presumptive remedies relevant to McClellan AFB will be incorporated in the decision rules for subsequent phases of investigation.

Uncertainty Limits

Phase I uncertainty will be addressed in terms of analytical precision, accuracy, representativeness, comparability, and completeness. If Phase I uncertainty criteria are met, the data may be sufficient to recommend the need for remedial action or NFI at a location (criteria for NFI locations are stated in the NFI Consensus Statement [McClellan AFB, 1993d]). If the uncertainty criteria and data are not sufficient to make decisions, additional data to perform a baseline risk assessment may be collected using a statistical sampling design.

For statistical sampling designs (to be employed during Phases II/III), several constraints on uncertainty will be included in the sampling design process. The constraints will be stated in quantitative terms that estimate the probability of making a wrong decision, such as:

- A 20% probability of remediating a location which does not need remediation (called false positive); or
- A 10% probability of not remediating a location that should be remediated (called false negative).

The EPA Guidance for Data Usability in Risk Assessment recommends a false positive risk of 20% (a confidence level of 80%); a 10% false negative risk (a power of 90%); and a Minimum Detectable Relative Difference (MDRD) of 10 to 40% for data sufficiency for a baseline risk assessment. The MDRD is the difference between the average concentration present at a location and a comparison level (such as background concentrations in soil, state or federal action levels, or ARARs) divided by the comparison level and expressed as a percentage.

Sample Design

The previous DQO elements lead to optimizing the design of the sampling plan. The design is dependent on the suspected source and contaminant type and any existing physical and analytical data. The specific approaches to designing an appropriate sampling plan are discussed in Section 4.3.

4.2.2 Data Evaluation DQOs

During Phase I, multiple levels of decisions will be made to prioritize sites for future remedial investigation phases or actions (Figure 4-2). The DQOs for data evaluation tasks are included in Tables 4-1 through 4-10. The same basic DQO process, as outlined in Section 4.2.1, was used to develop the data evaluation DQOs.

4.3 OU C Sampling Plan Designs

The optimal sampling design for an area is developed from information on the suspected source type, historical use, and any existing analytical and physical data.

4.3.1 Groundwater Characterization

HydroPunch® sampling will be conducted and groundwater monitoring wells will be installed to fill data gaps identified by the Groundwater OU and the OU C RI SAP teams. The rationale for selecting each groundwater sample location and the data gap to be filled are defined in the individual FSPs (Section 5).

4.3.2 Vadose Zone Characterization

Several types of source areas/discharge points have been identified in OU C (Figure 2-17). Areas that have the same source type commonly share the same type of suspected contaminants. This allows development of standard contaminant suites in these areas. Samples from each of the areas investigated in OU C will be analyzed for the applicable standard suite of contaminants. If additional contaminants of concern (COCs) are suspected, the individual FSP will outline the rationale for the additional COCs. Conversely, if any COC should be removed from the standard suite at a particular site, this will also be discussed in the FSP. The standard suite of analytes for each source type is shown in Table 4-11.

Field screening methods are quick and cost-effective tools for identifying areas with the highest concentrations. Screening methods and tools (e.g., scintillation counters and immunoassay test kits) will be used where applicable. Ten percent of the samples collected for field screening analysis will be sent off site for confirmational analysis. If screening results in an area are close to or exceed comparison criteria (e.g., clean-up goals), duplicate samples will be sent for off-site confirmational analysis and samples will be collected in deeper intervals to help define the vertical extent of contamination.

Soil gas sampling for volatile organic compounds (VOCs) is effective for characterizing contaminants at a location and identifying source areas. If VOCs are known or suspected in an area, then Phase I downhole soil gas sample locations will be placed approximately 100 feet apart in the suspected source area. Additional soil gas samples may be required to fill data gaps during later phases of the RI. Surface flux sampling may be conducted in Phase II of the RI after source areas have been better defined.

Decision Levels:	DECISION LEVEL I Field Sampling		DECISION LEVEL II Data Evaluation		DECISION LEVEL III Site Prioritization		
Purpose:	To clearly state what data will be gathered during the field investigation.		To clearly state what decisions will be made using each data evaluation tool.		To clearly state the criteria that will be used to priori- tize sites for remedial action, additional investi- gation, and no further investigation.		
Specific DQOs or Data Evaluation Tools:	Location-specific field sampling DQOs are presented in each FSP (Section 5). Data validation procedures are in the basewide QAPP.	⇨	Geostatistical analysis (TIS); Background comparison; Geologic modeling (TIS); 3-D plume modeling (TIS); Mass Estimates; Vadose zone modeling; Screening risk assessment; ARAR review; Technology screening; Conceptual model update.	⇨	Site Prioritization.	⇨	CLEANUP
Documentation:	The field sampling/ analysis results will be documented in the Phase I QA/QC Report and location-specific RI documents.		Data evaluation results will be documented in location-specific RI documents.		Air Force/Agency meeting summarizing Phase I results, prioritization, and recommendations.		
Outcome:	Data generated during the field effort will be used to make Level II decisions.		Data evaluation results will be used to make Level III decisions.		Establish new DQOs based on decisions made, short term objectives, and long term goals.		

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Figure 4-2. Conceptual Design for Phase I Data Quality Objectives

TABLE 4-1. DECISION LEVEL II -- GEOSTATISTICAL ANALYSIS

Problem Statement The 3-dimensional spacial relationship between discrete point samples is unknown and must be accurately modeled to calculate realistic target volumes and masses.
Decision to be Made Does a spacial relationship exist for the contaminant?
Inputs to the Decision Level II/III soil and soil gas data; and Professional judgement.
Data Evaluation Boundaries All useable lithologic and chemical data collected at the location.
Decision Rules If a spacial relationship exists then use it to build a plume model to determine the target volume and mass of contamination; If no spacial relationship exists then build a plume model using the inverse distance method.
Sources of Uncertainty Experience in recognizing trends, relationships, and visualizing the plume. Inappropriate manipulation of the data. Analytical data quality.
Data Evaluation Method/Design Use the Lynx Geotechnical Modeling System to evaluate data and perform 3-D geostatistical analysis.

TABLE 4-2. DECISION LEVEL II — INORGANIC CONSTITUENT COMPARISON TO BACKGROUND VALUES

Problem Statement

Stream sediments, surface soils, and subsurface soils may be contaminated with inorganic constituents and require remediation.

Decision to be Made

Are stream sediments, surface soils, subsurface soils, and/or groundwater contaminated with inorganic constituents?

Inputs to the Decision

Level II/III analytical data;
Sediment, surface soil, and subsurface soil background values (from Background Consensus Statement).

Data Evaluation Boundaries

Inorganic analytical data for a location.

Decision Rules

1. If the concentration of an inorganic constituent at a location is < background, then the inorganic constituent is not of concern.
2. If the concentration is > background, then the constituent will be included in the risk assessment.
3. If there is no logical discharge point, concentrations > background are restricted to an isolated sample (laterally and vergically), and the constituent is not > background in an exposure pathway or will not migrate to an exposure pathway, then the constituent is not of concern.

Sources of Uncertainty

Analytical methods used to analyze samples (e.g., ICP vs. AA).
Basewide background values may not be representative of a localized area (e.g., black sands in OU C1).
Analytical data quality.

Data Evaluation Method/Design

Background Consensus Statement decision flow chart.

TABLE 4-3. DECISION LEVEL II — GEOLOGICAL MODELING

Problem Statement The geologic features and lithology that effect contaminant migration and remediation decisions vary greatly across McClellan AFB.
Decision to be Made Are there lithologic and/or other geologic features at the location that influence contaminant migration or remedial alternatives selection?
Inputs to the Decision Descriptions of sediment and soil; Lithologic descriptions and interpretations from previous McClellan AFB projects; Conceptual model of geology beneath McClellan AFB; and Modeler's experience using the model and McClellan-specific experience (professional judgement).
Data Evaluation Boundaries Ground surface to the A groundwater monitoring zone within 20-100 feet of borings drilled at the location.
Decision Rules If the controlling features for contaminant migration and a remedial alternative has been selected, then no more geologic data may be needed during the RI.
Sources of Uncertainty Lithologic descriptions (e.g., was secondary porosity noted?); Conceptual model for McClellan AFB (depositional environment); Drawing correlations between soil types between borings.
Data Evaluation Method/Design Use Lynx Geotechnical Modeling System for 2- and 3-dimensional models. Soil type/permeability groupings based on relative permeability. 2D geologic sections will not be "linked" together. 2D geologic sections should be between 20 and 100 feet thick.

TABLE 4-4. DECISION LEVEL II — 3-DIMENSIONAL PLUME MODELING

<u>Problem Statement</u> The distribution of contaminants are only known from point data (i.e., borehole samples).
<u>Decision to be Made</u> Has sufficient data been collected to define the extent of known *hot spots* (areas of highest contamination at a location)? Where should additional borings be located?
<u>Inputs to the Decision</u> Level II/III data (e.g., Method 18 with 10% TO-14 confirmation); 2-D/3-D geological model; Statistical and geostatistical analysis results; Modeling parameters (e.g., search radius, nugget effect).
<u>Data Evaluation Boundaries</u> Ground surface to A Monitoring Zone; Lithologic layers or components for modeling within a specific component (e.g., low permeability zones) to determine volume and mass; The distance within the search radius of the model.
<u>Decision Rules</u> If plume modeling indicates that a *hot spot* has been defined to the extent necessary to make a remediation decision, then no more chemical data is needed; If the confidence for a geostatistically derived concentration within a grid cell is low in an area of concern, then a boring should be drilled in the grid cell or area (depending on how many grid cells have low confidence values and the contaminant concentrations expected) to increase the confidence.
<u>Sources of Uncertainty</u> Analytical methods; Statistical and geostatistical analysis; Inverse distance and geostatistical modeling; Analytical data quality.
<u>Data Evaluation Method/Design</u> Geostatistical modeling will be used for each location if a spacial relationship can be easily identified for an analyte (i.e., little data manipulation is needed [<8 hours]); If spacial relationships are difficult to determine for an analyte, then use existing geostatistical models generated for similar source and contaminant conditions (e.g., TCE plume for an unpaved storage area) to prepare model. Inverse distance modeling will be used if no spatial relationship is identified.

TABLE 4-5. DECISION LEVEL II — MASS ESTIMATES

Problem Statement Contaminant mass estimates are necessary to accurately select and design remedial alternatives.
Decision to be Made What is the total contaminant mass at the location and what is the mass per cubic yard?
Inputs to the Decision Level II/III soil and soil gas data; physical and chemical parameter data from literature; lithologic descriptions; and volume estimates.
Data Evaluation Boundaries Physical and chemical data within target volumes above a cut-off concentration.
Decision Rules If the contaminant mass is highest in the shallow (less than 50 feet BGS) vadose zone, then contamination has most likely originated from a surface or near surface source area/discharge point. If the contaminant mass is highest in the deep (greater than 50 feet BGS) vadose zone, then a contaminant smear zone exists beneath the location or contamination is the result of an old surface/near surface source that has migrated to the deep vadose zone. If the contaminant mass is distributed similarly throughout the vadose zone, then contamination has migrated vertically with depth from a recent or active surface/near surface source.
Sources of Uncertainty Extent of contamination; Volume calculations; Chemical/physical parameter data; Equilibrium assumptions between soil and soil gas; and Analytical data quality.
Data Evaluation Method/Design Use a simple "box" calculation to estimate mass or use the Lynx Geotechnical Modeling System to estimate target volumes and mass.

TABLE 4-6. DECISION LEVEL II - VADOSE ZONE TRANSPORT MODELING

Problem Statement

Contaminants may migrate to an exposure pathway in the future.

Decision to be Made

Will contaminants migrate to the air or groundwater exposure pathway in the modeled time interval?

Inputs to the Decision

Level II/III soil and soil gas analytical data from the groundwater to the water table (approximately 100' BGS);
Physical parameter data (moisture, grain size, permeability, etc) measured by ASTM-approved methods;
Borehole lithologic descriptions;
3-D geologic model of location using permeability groupings;
Various physical and chemical parameters from literature;
2D VAPOUR-T results; and
Simple analytical transport model results for non-VQCs and NAPLs.

Data Evaluation Boundaries

Ground surface to the capillary fringe to calculate leachate concentrations and surface flux estimates.

Decision Rules

If the maximum VOC soil gas concentrations reaching the ground surface in the modeled time interval would not be detectable using current analytical methods, then the VOCs will not impact the air exposure pathway;
If the maximum VOC concentrations in soil gas and/or non-VOC concentrations in soil reaching the top of the capillary fringe in the modeled time interval would not be detectable using current analytical methods, then the contaminants will not impact the groundwater exposure pathway.

Sources of Uncertainty

The uncertainty in model results can not be quantified and the uncertainty in predicting concentrations increases with the time interval modeled;
Analytical method detection limits (MDLs) may decrease with time and allow detection of concentrations that would not be detected with current technology; and
Physical parameters which come from the literature may not approximate the conditions at McClellan AFB and increase variability in the model predictions.
Analytical data quality.

Data Evaluation Method/Design

VOCs will be modeled with VAPOUR-T for a minimum of 30 years using both uncovered and covered (if the location is now covered) scenarios; and Non-VOCs will be modeled for 30 years using simple analytical models. If 30-year model results indicate contaminant concentrations will be equal to or greater than 0.1 x MDL, modeled interval will be extended to 50 years.

TABLE 4-7. DECISION LEVEL II — SCREENING HEALTH RISK ASSESSMENT

<u>**Problem Statement**</u> Contaminants may pose a health risk.
<u>**Decision to be Made**</u> Would contamination at the location result in unacceptable excess carcinogenic and/or non-carcinogenic risk for hypothetical residents at the location?
<u>**Inputs to the Decision**</u> Level II/III soil data; Maximum VOC concentration in leachate estimated from vadose zone modeling; Maximum non-VOC concentrations in leachate estimated from sample analytical model; Maximum VOC fluxes to the air estimated from vadose zone modeling; U.S. EPA and Cal/EPA slope factors and reference doses; and Exposure and pathway assumptions from Risk Assessment Consensus Statement (RACS).
<u>**Data Evaluation Boundaries**</u> Soils: Ground surface to 1 foot BGS; Leachate concentrations at top of water table as estimated by vadose zone modeling at the end of a simulated 30-year or longer interval; VOC surface flux emissions from the ground surface at the location as estimated by vadose zone modeling.
<u>**Decision Rules**</u> If the excess cancer risk for groundwater is $< 10^{-6}$, then there is no carcinogenic risk associated with VOCs or non-VOCs migrating to groundwater; If the hazard index for groundwater is < 1, then there is no non-carcinogenic risk associated with VOCs or non-VOCs migrating to groundwater; If the excess cancer risk for air is $< 10^{-6}$, then there is no carcinogenic risk associated with soil gas migrating to the air; If the hazard index for air is < 1, then there is no non-carcinogenic risk associated with soil gas migrating to the air; If the excess cancer risk for near surface soil is $< 10^{-6}$, then there is no carcinogenic risk associated with soils; If the hazard index for near surface soil is < 1, then there is no non-carcinogenic risk associated with soils; If the total excess cancer risk is $< 10^{-6}$, and the hazard index is < 1 then the results of the SHRA support an NFI recommendation.
<u>**Sources of Uncertainty**</u> Toxicity factors; Analytical data quality; Modeling results.
<u>**Data Evaluation Method/Design**</u> The SHRA will follow the method described in RACS. The SHRA process is designed to be conservative so NFI decisions can be made with confidence.

TABLE 4-8. DECISION LEVEL II - ARAR EVALUATION

<u>Problem Statement</u> Contaminant concentrations may exceed ARARs (county, state, and federal) and require remediation.
<u>Decision to be Made</u> Do contaminant concentrations exceed ARARs?
<u>Inputs to the Decision</u> Level II/III data; Vadose zone modeling results; Contaminant-specific ARARs; and Location-specific ARARs.
<u>Data Evaluation Boundaries</u> All usable data collected within the boundaries of the location.
<u>Decision Rules</u> If measured contaminant concentrations exceed ARARs, then consider site for remediation. If the future migration of contaminants, using predictive modeling, will result in ARARs exceedances (i.e., if contaminants will migrate to groundwater in the future and will increase groundwater contaminant concentrations above MCLs), then consider site for remediation.
<u>Sources of Uncertainty</u> Analytical data quality.
<u>Data Evaluation Method/Design</u> Records search for ARARs and TBCs; Evaluation of ARARs to determine if ARARs or TBCs are relevant; and Comparison of contaminant concentrations to ARARs.

TABLE 4-9. DECISION LEVEL II — TECHNOLOGY SCREENING

Problem Statement The most cost-effective and feasible technology should be selected for remediation.
Decisions to be Made What are the proven and innovative technologies for remediating the location? Is the location suitable for demonstrating a new or innovative technology that could reduce the total cost of cleanup at McClellan AFB?
Inputs to the Decision Level II/III data; Physical parameters measured by ASTM approved methods; Lithologic descriptions; and Previous reports summarizing remedial technologies.
Data Evaluation Boundaries Areas and COCs that may require remediation.
Decision Rules If there is a presumptive technology for the COC, then recommend presumptive remedy if cleanup is required; If a technology is suitable for the COCs and has been proven (e.g., pilot-scale test), then add to the list of proven technologies that may be used at the location; If a technology is suitable for the COCs and has not been proven (e.g., no pilot-scale test), then add to the list of innovative technologies that may be used at the location; and If a technology is suitable for remediating the COCs at the location and has not been tested at McClellan AFB, then recommend pilot-scale testing.
Sources of Uncertainty Low uncertainty for proven technologies; and High uncertainty for unproven technologies (i.e., innovative).
Data Evaluation Method/Design Use existing reports produced by the DOD and EPA to perform initial screening. Evaluation of ARARs to determine if ARARs or TBCs are relevant; and Comparison of physical parameters and contaminant concentrations to technology specifications.

TABLE 4-10. DECISION LEVEL III - SITE PRIORITIZATION

Problem Statement All locations characterized by sampling and analysis must be prioritized.
Decision to be Made Does location characterization data indicate a high, moderate, or low priority?
Inputs to the Decision Vadose zone modeling results; Screening health risk assessment results; 3-D geologic and plume modeling results; Community concerns; Regulatory concerns; and Ranking matrix.
Data Evaluation Boundaries The area within the boundaries of the location.
Decision Rules The grouping of the locations into high, moderate, and low priority will be reached by consensus between the Air Force, regulatory agencies, and RI contractor, and public.
Sources of Uncertainty Determining ranking numbers and dividing them up into high, moderate, and low priorities.
Data Evaluation Method/Design Use of the site prioritization matrix table; and Consensus of the parties of the IAG.

TABLE 4-11. PHASE I STANDARD CONTAMINANTS OF CONCERN BY SOURCE TYPE

	Soil Gas	Soil								
	VOCs	SVOCs	TPH		Heavy Petroleum Hydrocarbons	Organic Lead	PAHs	PCBs	Dioxins/ Furans	Metals
Source Type	FGC/TO-14	SW8270	Mod SW8015/3550	Mod SW8015/5030	E418.1	HML 338	SW8310	SW8080	SW8280	SW6010[a]
Known pits[b,c] and landfills	✓	✓	✓	✓				✓	✓	✓
Suspected pits	✓	✓	✓	✓						✓
Ponds	✓	✓	✓							✓
Creeks/drainages		✓	✓	✓[i]						✓
Sumps	✓	✓	✓	✓						✓
Storage	✓	✓								✓
Firing ranges		✓[d]								✓[e]
IWL[f]	✓									
Gasoline USTs	✓		✓	✓		✓				
Diesel USTs			✓							
Waste oil tank	✓		✓	✓	✓		✓			
Oil/water separator	✓		✓	✓	✓					
Unknown	✓	✓	✓	✓						✓
Maintenance/industrial	✓	✓	✓	✓						✓

(Continued on following page)

TABLE 4-11. (Continued)

	Soil						Groundwater		
	Arsenic	Selenium	Mercury	Chrome VI	Cyanide	pH	SVOCs	VOCs	Metals
Source Type	SW7060	SW7740	SW7471	E218.6	SW9012	SW9045	SW8270	SW8260	SW6010D[h]
Known pits/landfills	✓	✓	✓	✓[g]	✓	✓	✓	✓	✓
Suspected pits							✓	✓	
Ponds								✓	
Creeks/drainages									
Sumps									
Storage								✓	
Firing ranges									
IWL							✓	✓	
Gasoline USTs								✓	
Diesel USTs								✓	
Waste oil tank								✓	
Oil/water separator								✓	
Unknown								✓	
Maintenance/industrial								✓	

[a] Areas with concentrations above background, as identified by Method SW6010, will be further evaluated during Phase II for analysis by U.S. EPA SW7000 and SW9000 series methods.
[b] Thallium will be analyzed in Phase II by Method 7841 only if Phase I SW6010 results are positive.
[c] Phase I borings in known landfill locations will be cased through the waste material (see Section 5).
[d] Some samples will be analyzed by SW8270 since SVOCs were detected in soil from firing ranges at other Department of Defense facilities.
[e] Samples will be submitted for total and soluble copper and lead only.
[f] During Phase I, soil gas samples will be collected in borings placed along the IWL. Once discharge points of contamination have been identified from Phase I data, soil samples may be collected in the areas of concern. Soil samples will be collected in Phase I, however, in one boring placed adjacent to a known plug in the line (see the FSP for IC14).
[g] Some, but not all, of the samples will be analyzed for Chrome VI.
[h] Dissolved metals.
[i] Mod SW8015/5030 will be collected close to suspected source areas where the volatile fraction of TPH may not have volatilized to the atmosphere.

Soil samples will be collected at various depths in areas where non-VOC contamination is suspected in the deep vadose zone (greater than 20 feet BGS). Within the same boring, several samples will be collected and analyzed sequentially; the shallowest sample will be analyzed first and subsequent samples (deeper) will be analyzed if concentrations in the shallower sample exceed background. This process will be followed for each sampling interval until the vertical extent of non-VOC contamination has been determined. Samples collected for analysis by methods with short holding times (less than 14 days) will be analyzed at each depth sampled. For remaining samples, the laboratory will be notified that sequestial analyses will be performed and that holding times must be met. The deepest sample analyzed for total metal concentrations (using the sequential comparison method) will also be analyzed for soluble metal concentrations. This sequential method will not be used in pits/landfills where a heterogeneous mixture of contaminants is expected and all samples collected will be analyzed.

Approximately 10 feet beneath each pit/landfill, samples will be collected to determine total and soluble concentrations of inorganic constituents. Samples collected for soluble metals will be held in the laboratory pending results of total metal concentrations from each boring at the site. The sample beneath each pit which yields the highest concentration of inorganic constituents relative to the constituents toxicity will be analyzed for soluble metal concentrations. (A constituent's reported concentration is divided by its residential preliminary remediation goal [PRG] to obtain a weighting factor. Weighting factors for each sample are summed and the sample with the highest total factor is analyzed for soluble concentrations.) The shortest holding time for these analyses is 28 days, which will be sufficient to drill all borings at a site, analyze samples for total concentrations, make comparisons to background, and analyze for soluble concentrations.

Samples beneath the pit/landfill will also be analyzed for semivolatile VOCs (SVOCs) soluble concentrations of SVOCs will be determined in Phase II, if necessary, after hot spots have been identified from Phase I data. The holding time for SVOC analysis is not long enough (14 days) for SVOC hot spot identification and subsequent soluble analysis of that hot spot sample when multiple borings are being drilled and evaluated.

The following strategies were used to select Phase I sample locations at specific discharge points or areas in OU C:

Storage Tanks

- If an underground storage tank (UST) is in place, one boring will be drilled adjacent to pipeline connections with the tank. The tanks location will be determined through a record search of Civil Engineering (CE) files or, if unsuccessful, through magnetic and electromagnetic geophysical surveys. Boring locations selected in the FSPs will be adjusted as necessary based on survey results.

- If the UST has been removed and its former location is not precisely known, a CE record search will be conducted. A boring will be placed in the center of the former tank location. Magnetic/ electromagnetic surveys will not be used to identify former tank locations — this method identifies buried metal objects. Ground penetrating radar (GPR) has been used to identify former tank locations in OU C, but has been

unsuccessful due to radar interference. Geophysics will, therefore, not be used to identify former tank locations.

- For aboveground storage tanks, borings will be placed in surface depressions where overland flow of liquid would collect or drain if the tank leaked or spilled; in areas of discolored soil, and in known spill locations.

Samples will be collected to a minimum of 20 feet below the deepest portion of each tank (or former tank location) to determine the vertical extent of contamination.

Pipelines

Borings along pipelines will be drilled adjacent to any known or historic leaks, cracks, or breaks in the line, and adjacent to manholes, sumps, and pipeline intersections. Borings will also be placed every 100 feet in areas identified during the 1993 IWL inspection as having a moderate or high potential for leakage. Soil gas samples will be collected in Phase I to identify contaminated areas. Subsequent sampling in Phases II/III may include soil sampling at identified discharge points. If a discharge is apparent from Phase I data but the release point cannot be identified, additional soil gas sampling locations may be necessary to fill data gaps.

Buildings

Borings will be placed at doorways, drains, or an other likely spill or release areas, and around the perimeter of the building.

Known Areas of Contamination

For areas of known contamination, samples will be collected where spills/releases occurred, in areas of previously detected contamination, and where there is physical evidence of contamination (e.g., surface stains or odors).

Drainage Ditches and Creeks

Samples will be collected at probable influent locations, downstream of confluences with other drainages, at areas of lower elevation where water or sediment might collect, and on the depositional side (inside corner) of bends in the stream.

4.3.3 Phase II/III Power Curves

The number of samples projected to meet Phase II/III uncertainty criteria associated with statistical sample designs will be determined using power curves for organic and inorganic analytes. The curves are based on the statistical approach described in the U.S. EPA Guidance for Data Useability in Risk Assessment (1992). The number of samples projected does not guarantee that uncertainty criteria will be achieved, but does provide a reasonable estimate of the amount of data needed.

Assumptions about the variability and distribution of contaminants were made in developing the curves. Table 4-12 describes these assumptions and impacts on data sufficiency if they are not valid. The validity of these assumptions will not be determined until samples have been collected and analyzed. *Location-specific data will be used to refine the power curves and determine if additional samples are needed to meet uncertainty criteria and DQOs for the next phase (if any) of the investigation.*

Four power curves, two each for inorganic and organic constituents, were developed for use in preparing Phase II/III sampling designs. Variability is the most important

TABLE 4-12. ASSUMPTIONS USED FOR THE EVALUATION OF STATISTICAL POWER

Assumption	Impact of Deviations
Copper in soil is representative of inorganics with average variability relative to background; arsenic in soil is representative of inorganics with high variability relative to background. This assumption is based on the background data summary statistics (McClellan AFB, 1993b). The estimated variability for PCBs are representative of organic contaminants with average and high variability in localized areas of OU C, based on observations in remedial investigations at similar sites.	If the variability (coefficient of variation) of the data for inorganic analytes is greater than that for the power curve used, then it may not be possible to detect a difference between background. LOCs and the average site concentration; additional samples will be needed to meet the MDRD and power constraints. If the variability is less than that for the power curve used, then differences could be identified and no more samples would be needed.
The variability of contaminant concentrations in localized areas of OU C will be equal to the variability of inorganics in background. Presumed true at sites where no releases of inorganics have occurred. If so, the release will be detectable greater than background.	The power to detect differences between average site concentration and background will decrease where the relative variability of contaminant concentrations is greater than background. This impact may be reduced, however, as on-site variability and the difference between the average concentration and background increases.
Samples analyzed will have less than 50% non-detected results for each area. The results of the chemical analyses follow the same distribution as the power curve.	The power for statistical comparisons that use distributions or comparisons based on nonparametric theories will potentially be less than that calculated in this evaluation (a t-test was the comparison method used to develop the power curves).

factor influencing the number of samples collected. The curves for arsenic and copper (Figures 4-3 and 4-4) represent inorganic constituents that have high and average variability, respectively, for background concentrations in subsurface soil. The distribution of arsenic is log-normal; copper is normally distributed. To represent areas where the variability of organic contaminants is expected to be high and average, two curves for polychlorinated biphenyls (PCBs) (Figures 4-5 and 4-6) were developed; both were assumed to be distributed log-normally (organic contaminants tend to be log-normally distributed). For the PCB curves, the coefficients of variation (variability factor) were set at 100 and 60 based on observations from other remedial investigations with similar site characteristics. The preliminary remediation goal for PCBs (0.11 mg/kg) was used as the comparison concentration for the PCB curves.

The appropriate curve(s) (of the four developed) for a given location and constituent will be selected by determining whether the variability is expected to be high or average, and, for inorganics, the probable contaminant distribution. Once the curve is identified, the number of samples projected to meet Phase II/III uncertainty will be determined and scaled up or down depending on the size of the area investigated.

The curves are based on classical statistics and do not account for size or spatial relationships within the sample area. Spatial considerations were, therefore, based on best professional judgement:

- An area of 200' x 200' (approximately 1 acre) was selected as a reasonable area for the number of samples projected. Locations in OU C will be scaled appropriately to determine the number of recommended samples.

- The total number of recommended samples for a given area will be distributed both horizontally and vertically (e.g., if 20 samples are recommended, samples could be collected at 0.25' and 3' BGS in 10 hand augers).

Sample locations will be identified by placing a grid over the boundaries of the location. Each grid cell will be numbered sequentially, and a random number generator will be used to select grid cells in which samples would be collected. If a judgmental sampling point exists in a given cell, that cell will be blocked out and will not be included for random selection.

Example 1 illustrates the use of power curves in a hypothetical situation. To test how

Example 1

A 2-acre pond may contain inorganic contamination. The pond will be sampled to determine whether contaminants have accumulated in the sediments. The power curve for copper best represents this location; the distribution of contaminants would be related to sedimentation from the pond water, and is expected to be rather homogeneous and have an average variability. The intersection of the 90% power and 40% MDRD on the copper power curve shows that approximately five samples are needed to determine if the average concentration at the location exceeds background levels. Since the pond covers 2 acres, a total of 10 samples will be collected. A grid will be projected across the pond, and each grid cell assigned a number. Then, a random number generator will be used to randomly select 10 grid cells for sampling.

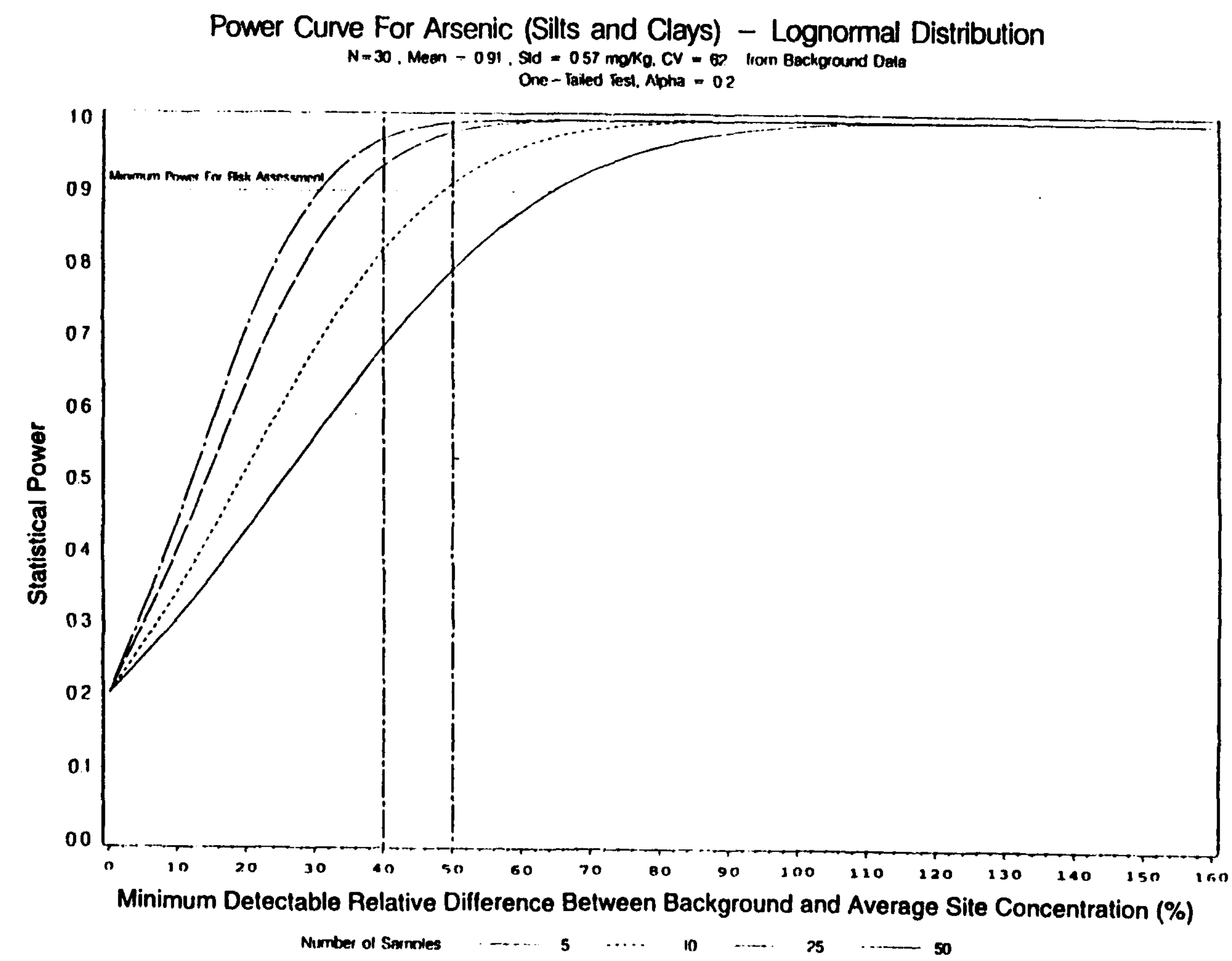

Figure 4-3. Power Curve for Arsenic (Silts and Clays) - Lognormal Distribution

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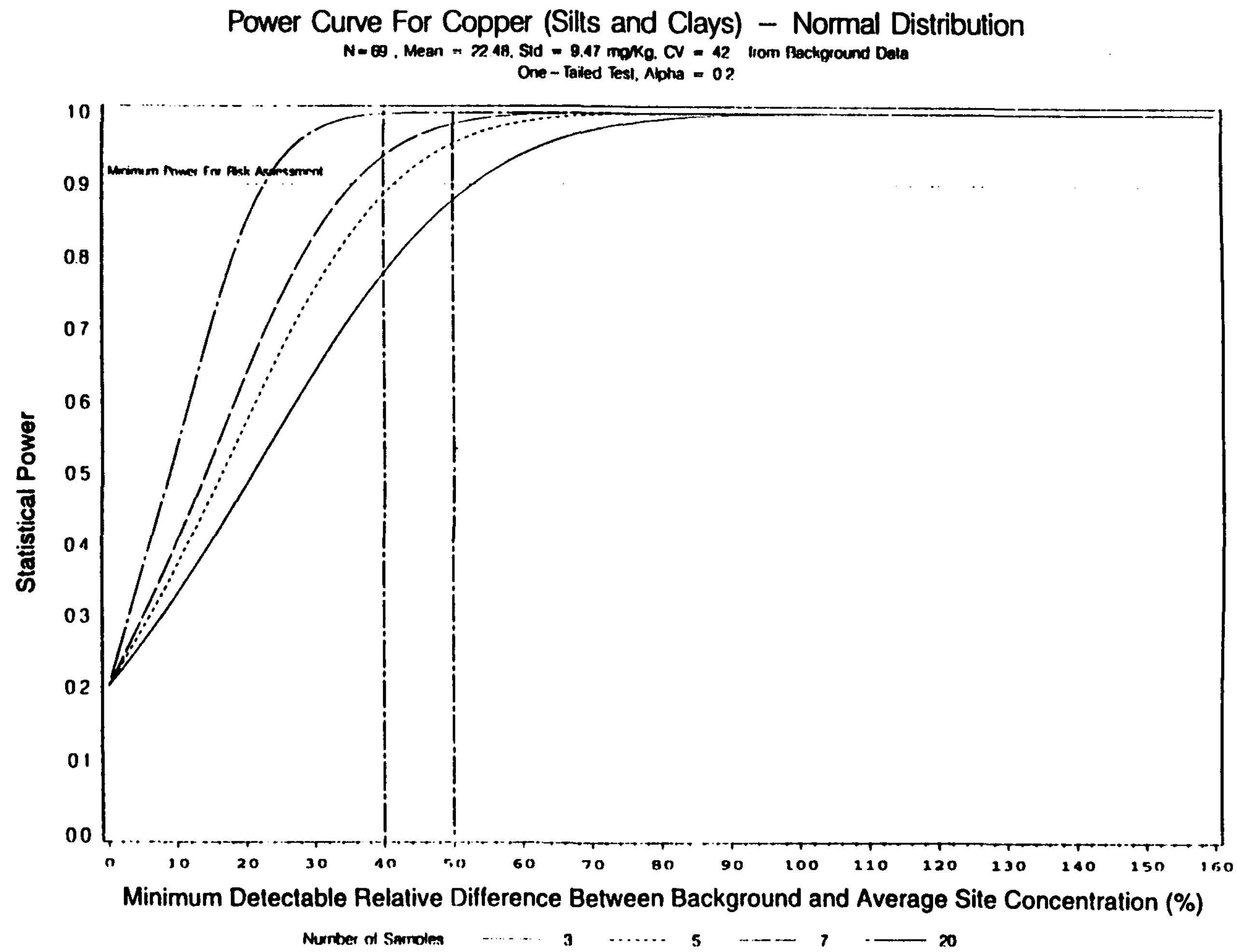

Figure 4-4. Power Curve for Copper (Silts and Clays) - Normal Distribution

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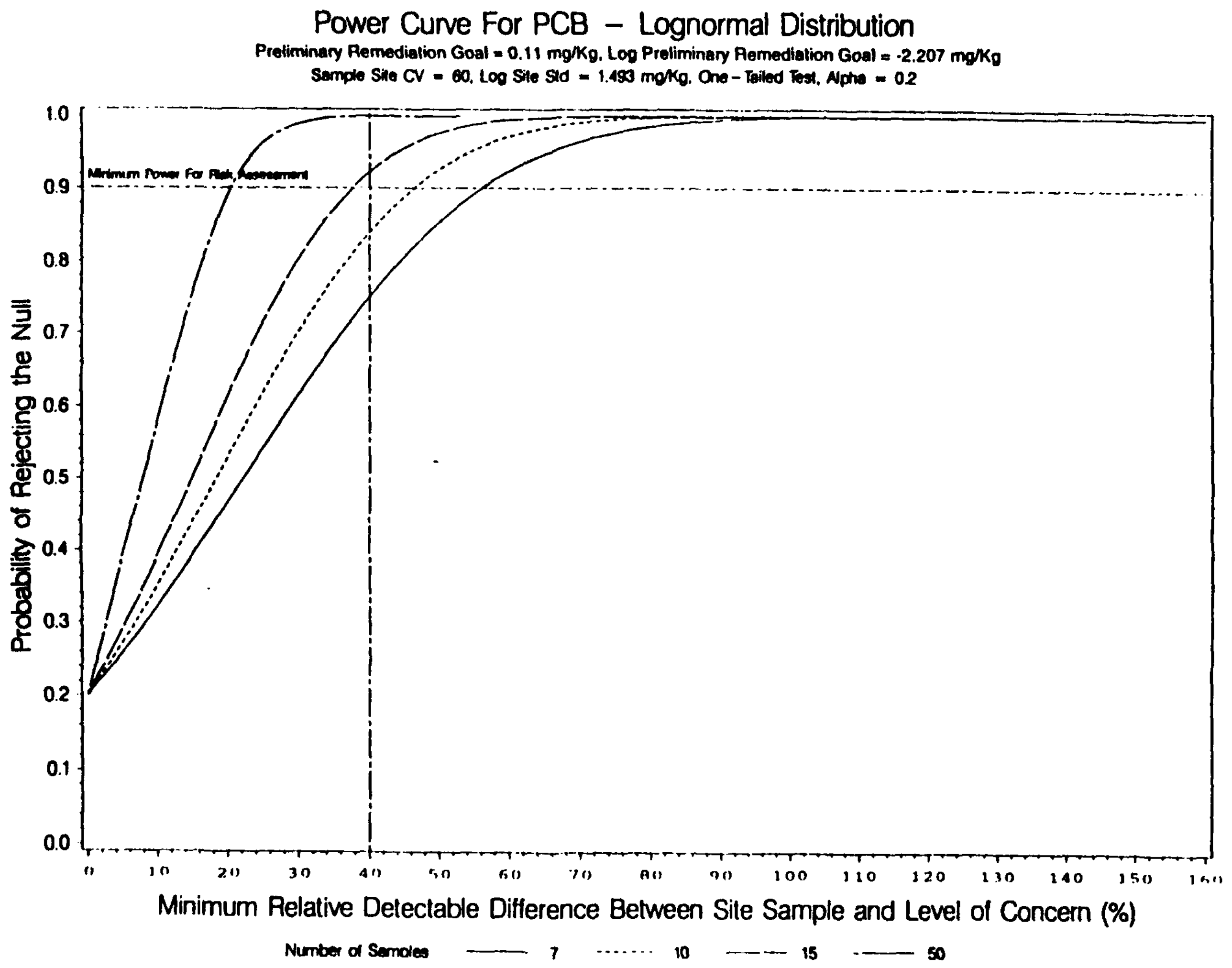

Figure 4-5. Power Curve for PCB - Lognormal Distribution, CV 60

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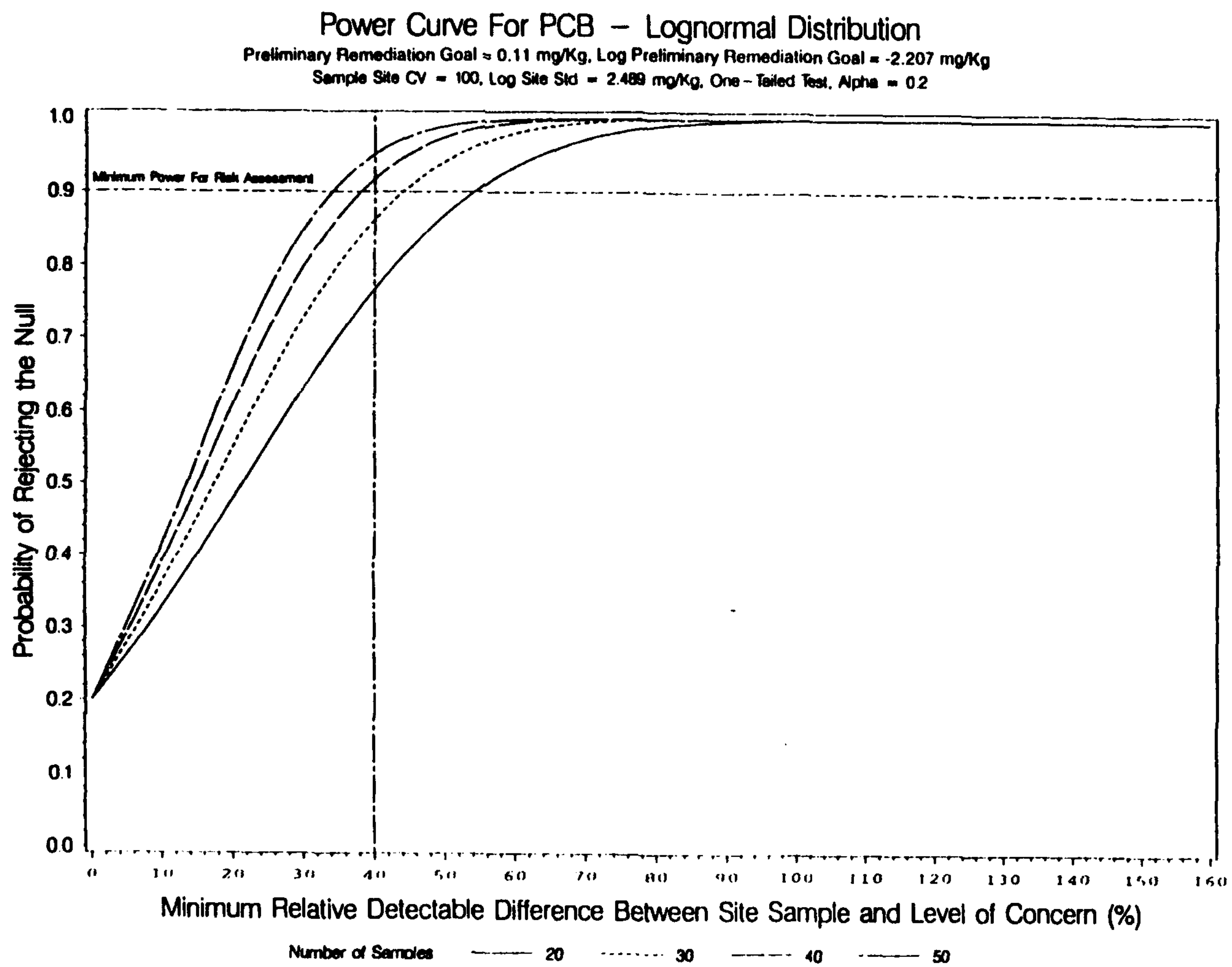

Figure 4-6. Power Curve for PCB - Lognormal Distribution, CV 100

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well the current curves work at an actual location, power curves were used retroactively on sample locations in OU B1 at McClellan AFB. Operable Unit B1 is a storage yard where PCBs exceeding 200,000 mg/kg were reported in surface soil samples (Radian, 1993b). Results of this evaluation showed that, using power curves to select the number of samples, and placing samples randomly in OU B1, the areas of highest contamination would still have been detected, and the effort would have cost less than the gridded sampling approach that was actually used.

After Phase II/III data are collected, the power curves (and the statistical assumptions used to generate them) will be evaluated. The objective of this evaluation is to determine whether sufficient data have been collected to resolve the difference between background levels for each constituent and the average concentration at a location. Location-specific results for inorganic constituents will be tested for normality, equal variance (to background), and other specific statistical tests. If these tests indicate that assumptions made in Phase II/III are valid, a power analysis will be performed for each constituent to verify that a sufficient number of samples were collected and determine if background levels were exceeded (within the confidence and power constraints). If the tests indicate that these assumptions were not valid for a constituent, or that an insufficient number of samples were collected, then the results for that constituent will be used in combination with the background data to develop location- and constituent-specific power curves. The additional number of samples needed for each constituent will be obtained from the specific curves.

4.4 Field Decisions

The site-specific FSPs (Section 5) outline sampling strategies designed to meet location-specific DQOs. The FSPs specify sampling locations and sample depths, based on previous knowledge of the location and anticipated contaminant migration. However, these plans are subject to modification in the field based on boring- and location-specific details, such as the depth of targeted lithologic layers, the location of buried drums, or underground utilities. This section describes decisions which will be made in the field.

Buried Objects in Landfills and Pits

Before any intrusive subsurface exploration takes place at known pits and landfills, geophysical surveys of the area will be performed. Electromagnetic and magnetic surveys will be used for identification of buried non-ferrous and ferrous objects, respectively. For both electromagnetic and magnetic surveys, more than one type of geophysical device may be used to assure adequate resolution of shallow (less than 10 feet) and deep subsurface profiles. The proper grid spacing will be determined once equipment has been procured and equipment specifications have been reviewed.

If buried drums are identified in the survey, the area will be trenched and the drum(s) removed. Any borings proposed in the immediate vicinity of the drum's location will not be drilled. Soil samples proposed at the boring location will be collected from the trench using a backhoe (maximum trench depth is 20 feet BGS). Drum excavation and sampling procedures for soil beneath the drum and any drum liquid are described in Appendix B.

If results of geophysical surveys are inconclusive, then trenches will be dug and borings will not be drilled in that area. If buried drums are not identified using geophysical methods, drilling in the pits and landfill will proceed as stated in the FSPs.

Sample Depth Determination

Prior to implementation of field work, cross sections trending through the area of planned boring locations will be prepared for the field crew. The Field Data Analysis Coordinator and Rig Geologist will review the cross sections to identify and target soil and soil gas sample depths as specified in the FSP. As the boring is drilled, the cross section will be updated with boring specific data to make correlations with existing data, target key lithologic units, and to assist with sample location selection at future nearby borings.

To obtain data that is correlatable with depth between borings, standard soil gas sampling depths have been established. Depth ranges for sample collection given in the individual FSPs are: 15'-25', 35'-45', 55'-65', 75'-85', and 90'-100' below ground surface BGS. Samples will be collected within the depth range and from thick (e.g., greater than 5 feet thick) and laterally continuous sandy layers. Sandy layers will be targeted for soil gas sample collection because of sampling limitations. The pore spaces of tighter layers (i.e., silts and clays) are not permeable enough to extract a representative soil gas sample.

Results of an OU B RI trend analysis study (Radian, 1993a) show that VOC concentrations in soil are greatest in fine-grained layers. This is due to the greater surface area available for adsorption in fine-grained layers. Silty or clayey layers will be targeted for soil sample collection during the RI.

The depths indicated in the FSPs are intended to guide the field sampling crew and are not rigid; the exact depth sampled in any boring will be based on boring-specific lithology and best professional judgment. The sample should, however, be collected within a few feet of the designated depth, if possible.

Physical Parameters

Soil samples for physical parameter measurements will be collected at locations throughout OU C. Borings in which samples will be taken have been preselected (see Field Sampling Plans) to assure geographic distribution across the operable unit. However, the specific depth or lithologic layers to be sampled in the borings will be determined in the field during drilling. Samples will be selected with the intent of characterizing the full range of soil types that occur beneath OU C. A Data Analyst will be available in the field to track physical parameter sample locations and ensure that representative samples are collected.

Although individual soil layers and lenses may change abruptly or gradually to another soil type within 50 feet laterally and 5 feet vertically, previous investigations at McClellan AFB indicate that the physical parameter values of widely separated samples of the same soil type occur within a narrow range. Therefore, widely spaced samples that include a variety of soil types in OU C will be sufficient for characterizing OU C soils.

Physical parameter measurements will be used to model contaminant transport through the vadose zone and for preliminary remedial design. Any physical parameter measurements that may be needed to finalize designs for specific areas of contamination will be collected during the remedial design phase.

Physical parameter measurements obtained during the OU C RI will consist of dry density and moisture content (both can be obtained with ASTM D2937). Grain size distribution (ASTM D422) data in OU C are available from previously drilled borings (McLaren, 1985). Total organic carbon values (SW9060 and Walkley Black) are available from OU C1 and are not significantly different than data collected in other OUs across McClellan AFB. The measurements will be used to estimate total porosity, water-filled porosity, air-filled porosity, saturated permeability, unsaturated permeability, mass of contaminants (in solid, liquid, and soil gas), and potential retardation effects of organic carbon on contaminant migration.

Method TO-14 Speciation of Unknown Compounds

An analyte list of potential OU C contaminants, shown on Table 2-1, has been prepared from existing OU C and OU C1 data. These COCs will be identified using a portable field gas chromatograph (FGC) or modified Method E-18. Ten percent of the samples will be confirmed off site by Method TO-14. If possible, a prefractionator (modified Method E-18) will be used in the field in conjunction with the FGC for identification of vinyl chloride. Vinyl chloride will also be confirmed off site using the prefractionator. *Detection limits for the FGC will be at least 1 ppmv.* The FGCs capability must be tested and proven prior to use on the RI. As field work is initiated, all samples will be confirmed by Method TO-14 until it has been shown that the FGC meets OU C RI specifications.

Soil gas samples will also be collected for Method TO-14 analysis if the portable FGC or modified Method 18 results indicate the presence of one or more unidentified compound(s) in the sample. If unknown compounds are present, a maximum of two samples per boring will be submitted for TO-14 analysis. Samples will be collected from intervals yielding the highest concentrations of unknown compounds. If possible, samples will be collected near the top and bottom of the boring to support migration potential calculations to the air and groundwater pathways. The TO-14 results will also be used to identify which compounds, if any, reported using a portable FGC or modified Method 18 are false positives and unusable.

Identification of Vinyl Chloride

Identification, quantification, and confirmation of vinyl chloride by FGC or modified Method 18 is not reliable. *Vinyl chloride is an analyte of concern and, therefore, if vinyl chloride is suspected, its presence will be confirmed by an analyte-specific method.* Currently, confirmational methods are being studied and developed by Radian Corporation and Air Toxics Limited in cooperation with McClellan AFB. Once a method has been perfected, a standard operating procedure (SOP) will be developed and amended to the OU C RI sampling and analysis plan (SAP).

Physical Evidence of Contamination

In subsurface layers where visual or physical evidence of soil contamination is apparent during drilling, soil samples will be collected. (In borings drilled by a cone penetrometer drill rig, visual monitoring will not be possible.) Samples will be collected for analysis from soil intervals:

- With discolored soil, odors, or debris; and
- Below buried drums (see Appendix B);

Samples will also be collected from soil yielding photoionization detector (PID) readings above 500 ppmv. These samples will be

screened for nonaqueous phase liquids (see Appendix B). Twenty-five percent of these samples (randomly selected) will be sent off site for analysis of VOCs.

The decision process used to select soil samples for analysis is shown in Figure 4-7.

Total Depth of a Boring

If total boring depth, as specified in the FSP, is reached and FGC analytical results from the boring indicate soil gas concentrations are increasing or are consistent with depth, the boring will be drilled an additional 20 feet (approximately) to a sandy interval, and a soil gas sample will be collected. If concentrations continue to increase or remain consistent, this process may continue until the boring reaches groundwater. A HydroPunch® sample will be collected if the boring is drilled to groundwater. Figure 4-8 outlines the decision-making process used to determine total boring depth.

Boring Conversion

All deep borings drilled will be evaluated for conversion to a SVE well, soil vapor monitoring well (SVMW), or groundwater monitoring well (GWMW). Analytical data and lithologic data will be evaluated, and a decision regarding conversion will be made within 48 hours of boring completion. Figure 4-9 outlines the decision process that will be used to determine if a boring should be abandoned or converted to a SVE well, SVMW, or a GWMW. Criteria for SVE conversion will be established in the next revision of the Quality Assurance Project Plan.

4.5 Data Evaluation

Operable Unit C includes 41 investigative sites and several non-site-specific areas which will be evaluated (see Figure 2-17 in Section 2). Data will be collected to characterize health and environmental risks resulting from discharges of chemicals. The need for action or no further investigation will be determined.

4.5.1 Data Evaluation Tools

To make informed decisions early in the process and help direct remedial activities, screening data will be collected and used to identify areas where sampling activities should be focused. Screening techniques include:

- Portable or mobile labs equipped with gas chromatograph or gas chromatography/mass spectrometry;
- Mobile labs equipped with inductively coupled plasma emissions and/or atomic absorption spectrometers;
- Nonaqueous phase liquid test equipment;
- Immunoassay kits; and
- Scintillation counters.

Standard operating procedures (SOPs) for immunoassay test kits are specific to the type of equipment used and, therefore, will be prepared for Air Force and regulatory agency review by the remedial investigation contractor.

These techniques provide quick and inexpensive methods to screen for contaminants. Subsequent sample locations can be placed with a higher level of confidence once the potential source area has been identified.

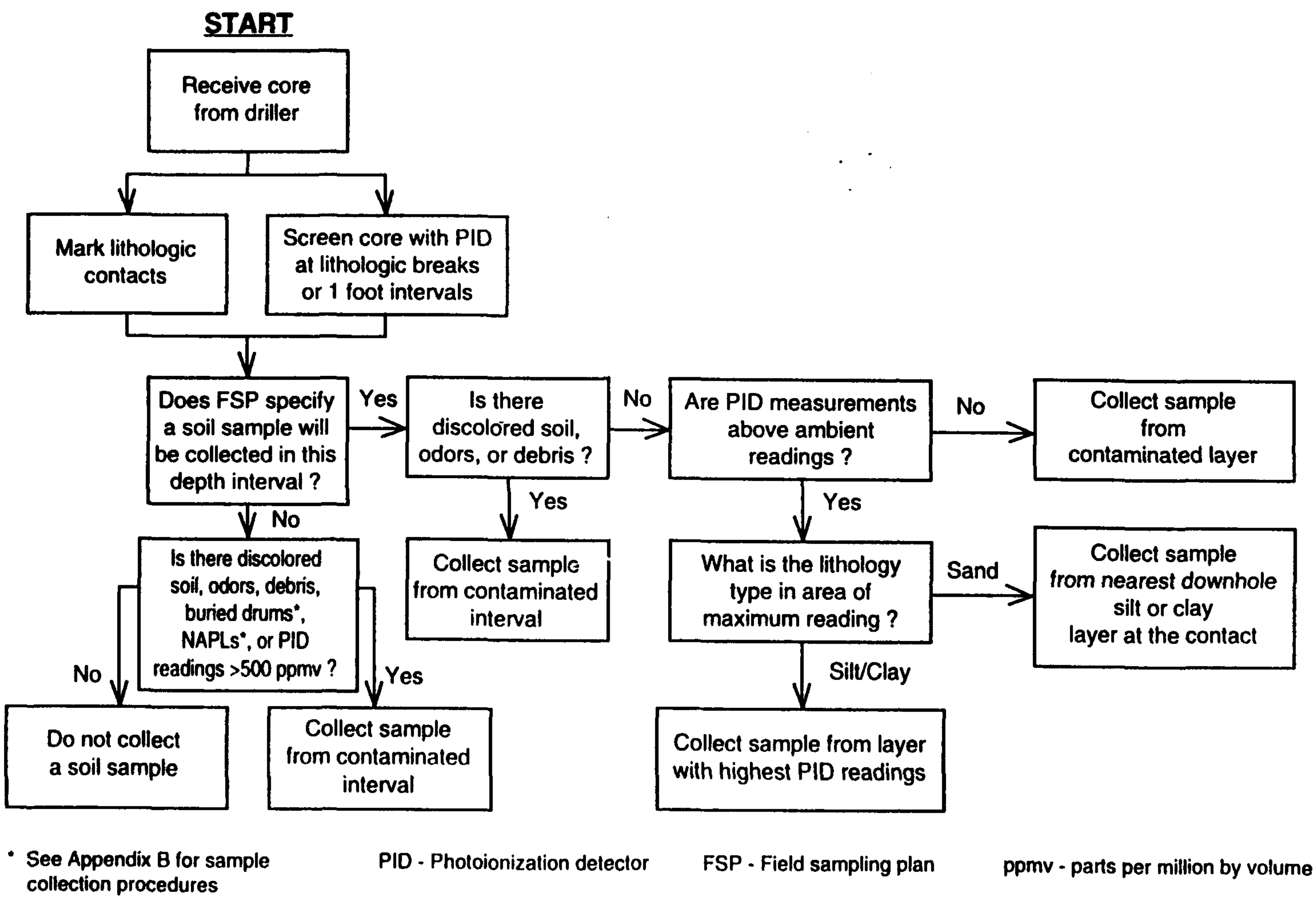

Figure 4-7. Soil Sample Collection Decision Diagram

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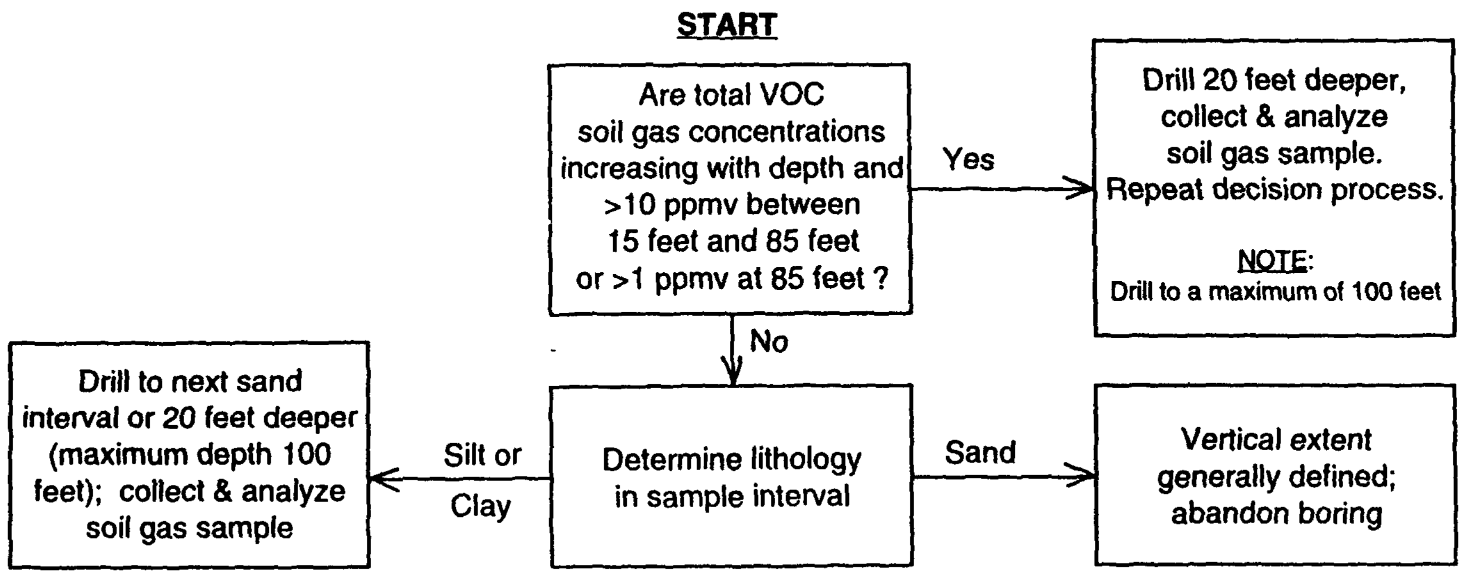

ppmv - Parts per million by volume
BGS - Below ground surface
VOC - Volaitle organic compound

Figure 4-8. Boring Depth Decision Diagram

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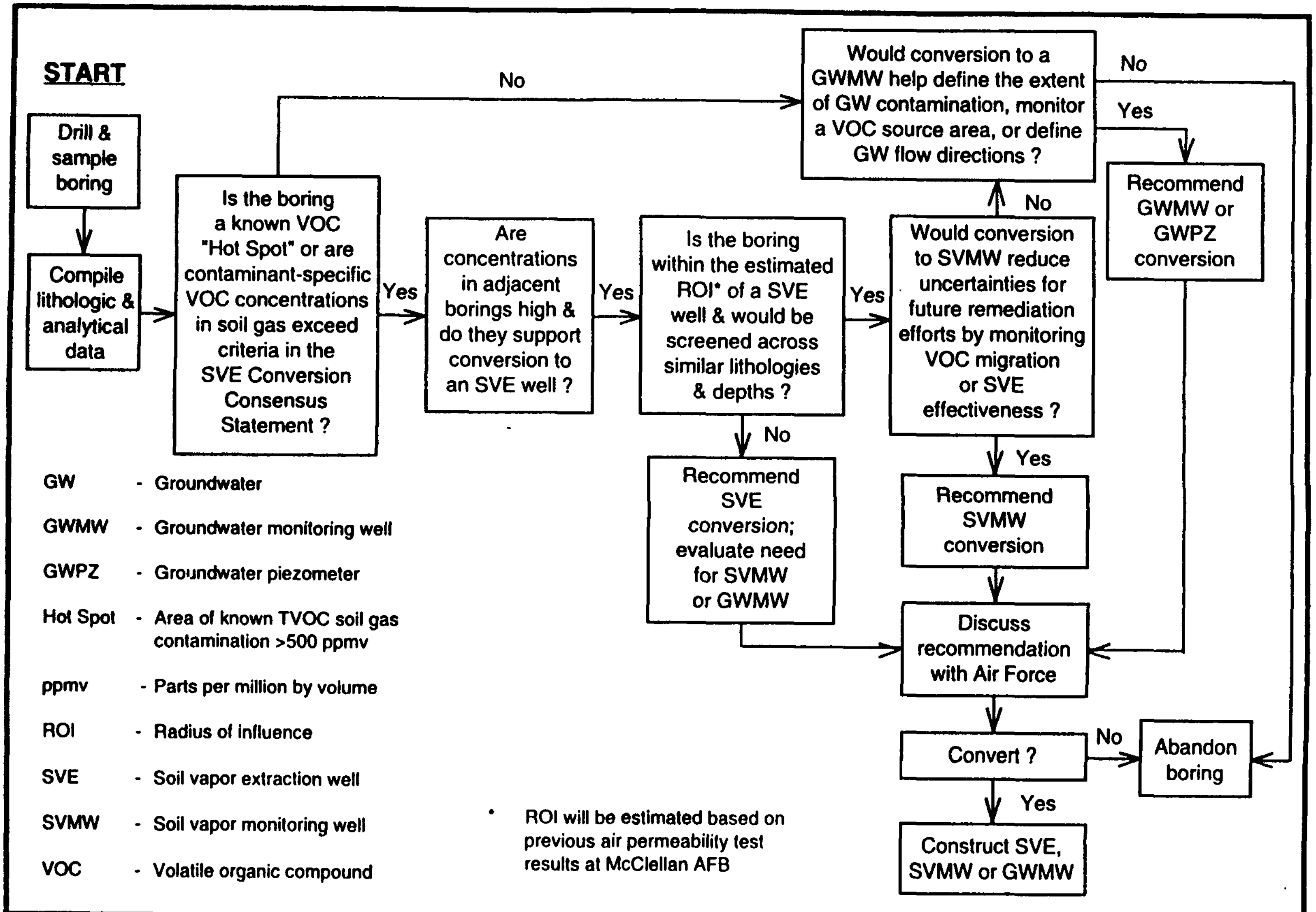

Figure 4-9. Boring Conversion Decision Diagram

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At a minimum, 10% of all data collected with screening methods will be sent to an off-site laboratory for analytical confirmation. Interpretations, however, such as source identification, contaminant migration, data trends, and exposure assessment will initially be made with the screening-level data, which may not be fully validated through the quality assurance and quality control process. Decisions made using unvalidated and unconfirmed screening data may be changed if validated/confirmed data indicate decisions were made in error.

Tools used to make data interpretations include the following:

- Technical Information System (TIS);
- Vadose zone modeling (VZM);
- Surface and subsurface background concentrations;
- Preliminary remediation goals;
- SHRA; and
- Trend analysis.

Each of these tools are discussed below.

TIS

A TIS system will be used to support data interpretations. This three-dimensional modeling system uses geostatistics to assist with definition of contaminant distribution (both horizontally and vertically). *Based on location-specific lithologic and analytical data, the TIS can determine spacial relationships of the contaminants and identify areas where additional data are needed.* Best professional judgement will be used to assist with stepout sample locations. The TIS will also be used to identify target volumes and estimate mass by contaminant. This information will be used to prioritize source areas and select remedy alternatives.

VZM

A vadose zone model will be used to evaluate the potential transport of VOCs through the mechanisms of vapor phase and dissolved aqueous phase migration in the subsurface. Modeling results will be used in the SHRA to determine location priorities. Contaminant-specific concentrations will be modeled for a minimum of 30 years. Thirty years is considered the reasonable maximum exposure for residential risk assessments (90th percentile). Location-specific data will be used to select model parameters for porous media characteristics, surface cover, surface water infiltration, and contaminant distribution. Non-VOC migration will be estimated using simple analytical models.

Background Concentrations

Concentrations of inorganics in soil presented in the Background Consensus Statement(s) will be used as a basis for comparison with RI analytical results to reach remedial response decisions, such as NFI, remedial action, or the need for additional sampling. Decision-making steps used to determine the potential for migration via an exposure pathway will be discussed in the upcoming consensus statement for sediment and surface soils (McClellan AFB, 1993c).

PRGs

Every quarter, the U.S. EPA Region IX (1994) publishes a list of PRGs, which are health-based concentrations in air, soil, and water. They can be used for general screening purposes, as "triggers" for further investigation at CERCLA sites, and as initial cleanup goals if applicable. The PRGs combine updated EPA toxicity values with health-

protective exposure assumptions to estimate contaminant levels in environmental media which correspond to a lifetime cancer risk of 1×10^{-6} risk and/or a hazard index of 1 for noncancer concerns. The PRGs for compounds previously detected in soil at McClellan AFB are listed in Table 4-13. Residential PRGs will be used for screening comparisons as they represent the most conservative value.

The PRGs are specifically not intended as a (1) stand-alone decision-making tool, (2) as a substitute for EPA guidance for preparing baseline risk assessments, or (3) a source of site-specific cleanup levels. They focus on dominant exposure pathways and do not include all exposure pathways encountered at McClellan AFB (such as soil gas). They are based on standard exposure assumptions for ingestion, inhalation, and dermal contact. Impacts to groundwater and ecological concerns are not considered in the calculation.

SHRA

Risks to receptors in a hypothetical on-site residential scenario for sites in OU C will be estimated by an SHRA. Worst-case and health conservative values will be used so that risks are not underestimated. As stated in the Risk Assessment Consensus Statement (McClellan AFB, 1993a), risk values calculated by the SHRA method can be used with confidence to identify sites that need no further investigation, providing contaminant concentrations do not exceed ARARs. The SHRA results will not, however, reflect the current risks because there are no residences in OU C.

Trend Analysis

Trend analysis will be a continuing process in which RI sampling criteria and techniques are evaluated statistically relative to analytical results. The objective of trend analysis is to test original hypotheses and refine techniques or assumptions, as needed, for future remedial investigations. Examples of trend analysis topics include an evaluation of analytical data obtained by different sample collection methods, an evaluation of different sampling designs, and an interpretation of the vertical distribution of soil gas concentrations.

4.5.2 Site Prioritization

Prioritization is a method used for ranking sites across an OU or basewide to establish the relative importance of a site compared to other sites. *Benefits of ranking are:*

- *Identifying locations for early action;*
- *Focusing remedial efforts on the "worst" locations (greatest potential for health or environmental risk), leading to early action to reduce risks to the public and the environment;*
- *Identifying locations which require no further investigation, focusing attention and resources to those sites that are likely to require action;*
- *Providing a measurement of RI progress as locations are periodically ranked; and*
- *Justifying funding for the program and ensuring that resources are directed first to those areas with the worst problems.*

The site prioritization process is a blending of quantitative and qualitative criteria to produce a relative ranking of the sites. It assesses the results of the RI to determine the need for no further action or remedial action. Locations at which this assessment cannot be made will require additional site characteriza

TABLE 4-13. RESIDENTIAL PRELIMINARY REMEDIATION GOALS FOR COMPOUNDS PREVIOUSLY DETECTED IN SOIL AT McCLELLAN AFB

Compound	PRG Concentration in Soil (mg/kg)	Compound	PRG Concentration in Soil (mg/kg)
Acenaphthene	36	Dimethyl phthalate	100,000
Acenaphthylene	80 [a]	2,4-Dimethylphenol	780
Acetone	9,200	Di-n-butyl phthalate	3,900
Anthracene	1.9	2,6-Dinitrotoluene	1.3
PCB Aroclor 1254	0.11	Endosulfan I	2.0 [c]
PCB Aroclor 1260	0.11	Endosulfan sulphate	2.0 [c]
Benzene	2.7	Ethylbenzene	310
Benzo(a)anthracene	1.2	Fluoranthene	1,600
Benzo(a)pyrene	0.12	Hexachloroethane	39
3,4-Benzofluoranthene	1.2	2-Hexanone	2,000 [d]
Benzo(g,h,i)perylene	80 [a]	Indeno(1,2,3-cd)pyrene	1.2
Benzoic acid	100,000	2-Methyl naphthalene	80 [a]
Benzo(k)fluoranthene	1.2	4-Methyl-2-pentanone	2,000
Benzyl alcohol	12,000	2-Methylphenol	2,000
bis(2-Ethylhexyl)phthalate	61	4-Mehtylphenol	200
2-Butanone	5,200	Naphthalene	80
Butyl benzyl phthalate	7,800	Nitrobenzene	20
4-Chloroaniline	160	N-nitrosodi-n-propylamine	0.12
Chlorobenzene	310	N-nitrosodiphenylamine	170
Chlordane	0.66	Pentachlorophenol	7.1
Chloroform	0.96	Phenanthrene	80 [a]
Chrysene	120	Phenol	23,000
4,4'-DDD	3.5	Pyrene	1,200
4,4'-DDE	2.5	Styrene	13,000
Dibenzo(a,h)anthracene	0.12	1,1,2,2-Tetrachloroethane	2.1
Dibenzofuran	0.000056 [b]	Tetrachloroethylene	22
1,2-Dichlorobenzene	230	Toluene	280
1,3-Dichlorobenzene	280	Total xylenes	99
1,4-Dichlorobenzene	17	trans-1,2-Dichloroethylene	620
3,3-Dichlorobenzidine	1.9	1,2,4-Trichlorobenzene	550
Dichlorobromomethane	2.9	1,1,1-Trichloroethane	300
1,1-Dichloroethane	410	Trichloroethylene	14
1,2-Dichloroethane	0.84	Vinyl chloride	0.0097
1,1-Dichloroethylene	700		
Dichloromethane	22		
1,2-Dichloropropane	1.3		
1,3-Dichloropropylene	1.0		
Diethyl phthalate	31,000		

[a] Naphthalene used as a surrogate.
[b] Used 2,3,7,8-TCDD toxic equivalent factor.
[c] Endosulfan used as a surrogate.
[d] Used 4-methyl-2-pentanone (methyl isobutyl ketone) as a surrogate.

PRGs are not available for 4-nitrophenol and 2-chloroethylvinyl ether.
Data from U.S. EPA, 1994.

tion to make that determination. The decision process is iterative; as data are collected and evaluated, locations will be ranked and re-ranked and progress will be measured. Figure 4-10 illustrates the process. Figure 1-5 (Section 1) illustrates how prioritization ranking fits into the overall RI process to make remediation decisions. Details on site prioritization will be available in the Prioritization Document (McClellan AFB, forthcoming).

4.6 Other Decisions

Other decisions that will be made during the OU C RI include identification of remedial alternatives and how to manage soil cuttings generated during field work.

4.6.1 Presumptive Remedies and Potential Remedial Technologies

Soil vapor extraction is the presumed remedy of choice for VOCs in soil and soil gas. Currently, SVE is being implemented through the SVE EE\CA at several locations across McClellan AFB. The SVE EE\CA provides a mechanism for early action at locations with HVOC soil gas contamination.

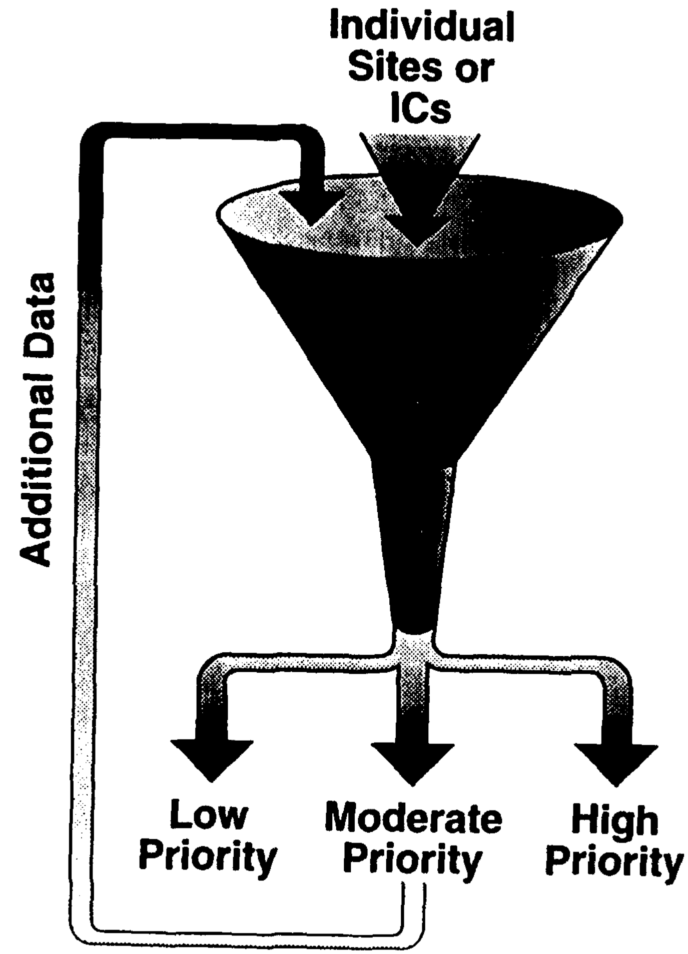
Bioventing is currently being implemented at McClellan AFB to remediate aromatic volatile organic compound (AVOC) and total petroleum hydrocarbon (TPH) contaminated soil and soil gas.

Other remedial action alternatives that may be considered in the FS were preliminarily identified so that data needs could be included in RI data collection activities. Table 4-14 lists possible remedial technologies for various contaminants and media. Potential remedial technologies were selected based on OU C specific characteristics and reviews of similar sites using established and emerging technologies. A complete screening of alternatives will be performed during the FS.

4.6.2 Classification of Hazardous Waste

Field activities during the OU C RI will generate soil cuttings. Because this soil may be hazardous, it will need to be managed appropriately (McClellan AFB, 1993e). During the OU C RI, excess subsurface soil will be put into drums. The drums will be labeled according to McClellan AFB procedures, indicating the location (e.g., boring number and depth range) the cuttings were derived from (McClellan AFB, 1992). For disposal, the cuttings are considered Toxicity Characteristic (TC) hazardous if, when subjected to the TC Leaching Procedure (TCLP) test method (40 CFR Part 261, Appendix II), they yield an extract containing any of 40 constituents at concentrations above those specified in 40 CFR Section 261.24.

To expedite the disposal of containerized soil, RI sample results will be compared to "quick and dirty" TCs (see U.S. EPA 53 Federal Register 51444, December 21, 1988, Section 1.2 of Appendix II to 40 CFR Part 261). Drums which contain soil with total waste concentrations greater than or equal to 20 times the TC regulatory concentration (derived from 40 CFR Section 261.24) are potentially a TC hazardous waste. Drums with soil at concentrations close to or above the relevant TC regulatory concentration will be verified by TCLP analysis or assumed to be hazardous and managed as such. Soil with concentrations well below the relevant TC concentration may be considered nonhazardous.



Prioritization Process

HIGH PRIORITY
Locations that require early action

MODERATE PRIORITY
Locations where additional data are needed to decide if remediation is necessary

LOW PRIORITY
Locations that require no further investigation

Figure 4-10. Prioritization Process

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Table 4-14. Remedial Technologies Scre

CONTAMINANTS/POLLUTANTS TREATED:
HVOC = Halogenated volatile organic compounds
HSVOC = Halogenated semivolatile organic compounds
NVOC = Nonhalogenated volatile organic compounds
NSVOC = Nonhalogenated semivolatile organic compounds
TPH = Total petroleum hydrocarbons
P = Pesticides
I = Inorganics
Target contaminants are listed first and in bold type.

RATING CODES:
■ = Better
○ = Average
▲ = Worse
I = Inadequate information
NA = Not applicable

NOTES:
[1] BLUE TYPE denotes *Presumptive Remedy*
[2] The listing of contaminant groups is intended as a general reference only. A technology may treat only selected compounds within the contaminant groups listed. Further investigation is necessary to determine applicability to specific contaminants.
[3] Conventional technologies/ processes

Media	Process Category - Remedial Technology[1]	Status - (F)ull-scale or (P)ilot-scale	Contaminants/Pollutants Treated[2] (see codes and comments at left)
Soil, Sediment, and Sludge	In Situ Biological Processes		
	- Biodegradation	F	**NVOC, NSVOC, TPH** HVOC, HSVOC, P
	- Bioventing	F	**NVOC, NSVOC, TPH** HVOC, HSVOC, P
	In Situ Physical/Chemical Processes		
	- Soil Vapor Extraction (SVE)	F	**HVOC, NVOC, TPH**
	- Soil Flushing	P	**HVOC, NVOC, I** HSVOC, NSVOC, TPH, P
	- Solidification/Stabilization[3]	F	**I** HSVOC, NSVOC, P
	- Pneumatic Fracturing (enhancement)	P	HVOC, HSVOC, NVOC, NSVOC, TPH, P, I
	In Situ Thermal Processes		
	- Vitrification	P	**I** HVOC, HSVOC, NVOC, NSVOC, TPH, P
	- Thermally Enhanced SVE	F	**HSVOC, NSVOC, P** HVOC, NVOC, TPH
	Ex Situ Biological Processes (assuming excavation)		
	- Slurry Phase Biological Treatment	F	**NVOC, TPH** HVOC, HSVOC, NSVOC, P
	- Controlled Solid Phase Bio. Treatment	F	**NVOC, TPH** HVOC, HSVOC, NSVOC, P
	- Landfarming[3]	F	**NVOC, TPH** HVOC, HSVOC, NSVOC, P
	Ex Situ Physical/Chemical Processes (assuming excavation)		
	- Soil Washing	F	**HSVOC, NSVOC, TPH, I** HVOC, NVOC, P
	- Solidification/Stabilization[3]	F	**I** HSVOC, NSVOC, P
	- Dehalogenation (Glycolate)	F	**HSVOC, P** HVOC
	- Dehalogenation (BCD)	F	**HSVOC, P** HVOC
	- Solvent Extraction (chemical extraction)	F	**HSVOC, NSVOC, P** HVOC, NVOC, TPH
	- Chemical Reduction/Oxidation	F	**I** NVOC, NSVOC, TPH, P
	- Soil Vapor Extraction (SVE)	F	**HVOC, NVOC**

Source: U.S. EPA

al Technologies Screening Matrix

ants/Pollutants Treated² s and comments at left)	Overall Cost (see rating codes at left)	Capital (CAP) or Operations & Maintenance (O&M) Intensive?	Commercial Availability (see rating codes at left)	Residuals Produced - (S)olid, (L)iquid, or (V)apor	Minimum Contaminant Concentration Achievable (see rating codes at left)	Addresses (T)oxicity, (M)obility, or (V)olume?	Long-Term Effectiveness/ Permanence? (see rating codes at left)	Time to Complete Cleanup (see rating codes at left)	System Reliability/Maintainability (see rating codes at left)
OC, TPH HVOC, HSVOC, P	○	O&M	■	None	○	T	Yes	▲	▲
OC, TPH HVOC, HSVOC, P	■	Neither	■	None	■	T	Yes	○	■
VOC, NVOC, TPH	■	O&M	■	L	○	V	Yes	○	■
, I HSVOC, NSVOC, TPH, P	I	O&M	■	L	▲	V	Yes	▲	○
HSVOC, NSVOC, P	■	Cap	■	S	NA	M	I	■	■
OC, NVOC, NSVOC, TPH, P, I	■	Neither	▲	None	NA	M	Yes	NA	■
VOC, NVOC, NSVOC, TPH, P	▲	Both	▲	L	NA	M	Yes	■	▲
VOC, P HVOC, NVOC, TPH	○	Both	○	L	○	V	Yes	■	○
HVOC, HSVOC, NSVOC, P	○	Both	○	None	○	T	Yes	○	○
HVOC, HSVOC, NSVOC, P	■	Neither	■	None	○	T	Yes	○	■
HVOC, HSVOC, NSVOC, P	■	Neither	■	None	○	T	Yes	▲	■
OC, TPH, I HVOC, NVOC, P	○	Both	○	S, L	○	V	Yes	■	○
HSVOC, NSVOC, P	■	Cap	■	S	NA	M	I	■	■
SVOC, P HVOC	▲	Both	○	L	■	T	Yes	▲	▲
SVOC, P HVOC	I	I	▲	V	I	T	Yes	I	I
VOC, P HVOC, NVOC, TPH	▲	Both	○	L	○	V	Yes	▲	○
VOC, NSVOC, TPH, P	○	Neither	■	S	NA	T, M	I	■	■
HVOC, NVOC	■	Neither	■	L	○	V	Yes	○	■

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(2)

Table 4-14. (continued)

CONTAMINANTS/POLLUTANTS TREATED:
HVOC = Halogenated volatile organic compounds
HSVOC = Halogenated semivolatile organic compounds
NVOC = Nonhalogenated volatile organic compounds
NSVOC = Nonhalogenated semivolatile organic compounds
TPH = Total petroleum hydrocarbons
P = Pesticides
I = Inorganics
Target contaminants are listed first and in bold type.

RATING CODES:
■ - Better
◐ - Average
▲ - Worse
I - Inadequate information
NA - Not applicable

NOTES:
[1] **BLUE TYPE** denotes Presumptive Remedy
[2] The listing of contaminant groups is intended as a general reference only. A technology may treat only selected compounds within the contaminant groups listed. Further investigation is necessary to determine applicability to specific contaminants.
[3] Conventional technologies/processes

Media	Process Category - Remedial Technology[1]	Status - (F)ull-scale or (P)ilot-scale	Contaminants/Pollutants Treated[2] (see codes and comments at left)
Soil, Sediment, and Sludge (continued)	Ex Situ Thermal Processes (assuming excavation)		
	- Low Temperature Thermal Desorption	F	**HVOC, NVOC, TPH** HSVOC, NSVOC, P
	- High Temperature Thermal Desorption	F	**HSVOC, NSVOC, P** HVOC, NVOC, TPH
	- Vitrification	F	**I** HVOC, HSVOC, NVOC, NSVOC, TPH, P
	- Incineration[3]	F	**HSVOC, NSVOC, P** HVOC, NVOC, TPH
	- Pyrolysis	P	**HSVOC, NSVOC, P** HVOC, NVOC, TPH
	Other Processes		
	- Natural Attenuation[3]	NA	**NVOC, NSVOC, TPH** HVOC, HSVOC, P
	- Excavation and Off-Site Disposal	NA	HVOC, HSVOC, NVOC, NSVOC, TPH, P, I
Groundwater	In Situ Biological Processes		
	- Oxygen Enhancement with H_2O_2	F	**NVOC, NSVOC, TPH** HVOC, HSVOC, P
	- Co-metabolic Processes	P	**HVOC, HSVOC** NVOC, NSVOC, TPH, P
	- Nitrate Enhancement	P	**NVOC, NSVOC, TPH** HVOC, HSVOC, P
	- Oxygen Enhancement with Air Sparging	F	**NVOC, NSVOC, TPH** HVOC, HSVOC, P
	In Situ Physical/Chemical Processes		
	- Slurry Walls (containment only)[3]	F	HVOC, HSVOC, NVOC, NSVOC, TPH, P, I
	- Passive Treatment Walls	P	**HVOC, HSVOC, I** NVOC, NSVOC, TPH
	- Hot Water or Steam Flushing/Stripping	P	**HSVOC, NSVOC, TPH** HVOC, NVOC
	- Hydrofracturing (enhancement)	P	HVOC, HSVOC, NVOC, NSVOC, TPH, P, I
	- Air Sparging	F	**HVOC, NVOC, TPH**
	- Directional Wells (enhancement)	F	HVOC, HSVOC, NVOC, NSVOC, TPH, P, I
	- Dual Phase Extraction	F	**HVOC, NVOC, TPH**
	- Vacuum Vapor Extraction	P	**HVOC, HSVOC, TPH** NVOC, NSVOC, P, I
	- Free Product Recovery[3]	F	**NSVOC, TPH**

Source: U.S. EPA

-14. (*continued*)

s/Pollutants Treated[2] and comments at left)	Overall Cost (see rating codes at left)	Capital (CAP) or Operations & Maintenance (O&M) Intensive?	Commercial Availability (see rating codes at left)	Residuals Produced - (S)olid, (L)iquid, or (V)apor	Minimum Contaminant Concentration Achievable (see rating codes at left)	Addresses (T)oxicity, (M)obility, or (V)olume?	Long-Term Effectiveness/ Permanence? (see rating codes at left)	Time to Complete Cleanup (see rating codes at left)	System Reliability/Maintainability (see rating codes at left)
TPH HSVOC, NSVOC, P	■	Both	■	L	■	V	Yes	■	○
:, P HVOC, HVOC, TPH	○	Both	■	L	■	V	Yes	■	○
IC, NVOC, NSVOC, TPH, P	▲	Both	○	L	NA	M	Yes	○	○
:, P HVOC, NVOC, TPH	▲	Both	■	L, S	■	T	Yes	■	○
:, P HVOC, NVOC, TPH	▲	Both	▲	L, S	■	T	Yes	■	I
TPH HVOC, HSVOC, P	■	Neither	■	None	I	T	Yes	▲	■
NVOC, NSVOC, TPH, P, I	▲	Neither	■	NA	NA	M	No	■	■
TPH HVOC, HSVOC, P	○	O&M	■	None	■	T	Yes	○	▲
NVOC, NSVOC, TPH, P	○	O&M	▲	None	■	T	Yes	○	▲
TPH HVOC, HSVOC, P	■	Neither	▲	None	■	T	Yes	○	○
TPH HVOC, HSVOC, P	■	Neither	■	None	■	T	Yes	○	■
NVOC, NSVOC, TPH, P, I	■	Cap	■	NA	NA	M	I	■	■
, I NVOC, NSVOC, TPH	I	Cap	▲	S	I	T	I	▲	I
C, TPH HVOC, NVOC	○	Cap	○	L, V	○	V	Yes	■	▲
NVOC, NSVOC, TPH, P, I	○	Neither	I	None	NA	M	Yes	■	■
C, NVOC, TPH	■	Neither	■	V	○	V	Yes	■	■
NVOC, NSVOC, TPH, P, I	I	Neither	▲	L, S	NA	NA	Yes	■	○
C, NVOC, TPH	○	O&M	■	L, V	○	V	Yes	○	○
TPH NVOC, NSVOC, P, I	○	Cap	▲	L, V	■	V	Yes	○	■
SVOC, TPH	■	Neither	■	L	NA	V	Yes	■	○

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(2)

Table 4-14. (continued)

CONTAMINANTS/POLLUTANTS TREATED:
HVOC = Halogenated volatile organic compounds
HSVOC = Halogenated semivolatile organic compounds
NVOC = Nonhalogenated volatile organic compounds
NSVOC = Nonhalogenated semivolatile organic compounds
TPH = Total petroleum hydrocarbons
P = Pesticides
I = Inorganics
Target contaminants are listed first and in bold type.

RATING CODES:
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○ = Average
▲ = Worse
I = Inadequate information
NA = Not applicable

NOTES:
[1] **BLUE TYPE** denotes Presumptive Remedy
[2] The listing of contaminant groups is intended as a general reference only. A technology may treat only selected compounds within the contaminant groups listed. Further investigation is necessary to determine applicability to specific contaminants.
[3] Conventional technologies/processes

Media	Process Category - Remedial Technology[1]	Status - (F)ull-scale or (P)ilot-scale	Contaminants/Pollutants Treated[2] (see codes and comments at left)
Groundwater (continued)	Ex Situ Biological Processes (assuming pumping)		
	- Bioreactors	F	**NVOC, NSVOC, TPH** HVOC, HSVOC, P
	Ex Situ Physical/Chemical Processes (assuming pumping)		
	- Air Stripping[3]	F	**HVOC, NVOC** HSVOC, NSVOC, TPH
	- Carbon Adsorption (liquid phase)[3]	F	**HSVOC, NSVOC** HVOC, TPH, P, I
	- UV Oxidation	F	**HVOC, HSVOC, P** NVOC, TPH
	Other Processes		
	- Natural Attenuation[3]	NA	**NVOC, NSVOC, TPH** HVOC, HSVOC, P
Air Emissions/ Off-Gas Treatment	- Carbon Adsorption (vapor phase)[3]	F	**HVOC, HSVOC, NVOC, NSVOC, TPH, P**
	- Catalytic Oxidation (non-halogenated)[3]	F	**NVOC, NSVOC, TPH**
	- Catalytic Oxidation (halogenated)	F	**HVOC, HSVOC**
	- Biofiltration	F	**NVOC, TPH** HVOC
	- Thermal Oxidation[3]	F	**NVOC, NSVOC, TPH**

Source: U.S. EPA

Table 4-14. (continued)

taminants/Pollutants Treated[2] e codes and comments at left)	Overall Cost (see rating codes at left)	Capital (CAP) or Operations & Maintenance (O&M) Intensive?	Commercial Availability (see rating codes at left)	Residuals Produced - (S)olid, (L)iquid, or (V)apor	Minimum Contaminant Concentration Achievable (see rating codes at left)	Addresses (T)oxicity, (M)obility, or (V)olume?	Long-Term Effectiveness/ Permanence? (see rating codes at left)	Time to Complete Cleanup (see rating codes at left)	System Reliability/Maintainability (see rating codes at left)
, NSVOC, TPH HVOC, HSVOC, P	■	Cap	■	S	O	T	Yes	NA	O
C, NVOC HSVOC, NSVOC, TPH	■	O&M	■	L, V	■	V	Yes	NA	O
VOC, NSVOC HVOC, TPH, P, I	▲	O&M	■	S	■	V	Yes	NA	■
VOC, HSVOC, P NVOC, TPH	O	Cap	■	None	■	T	Yes	NA	▲
, NSVOC, TPH HVOC, HSVOC, P	■	Neither	■	None	I	T	Yes	▲	■
C, HSVOC, NVOC, NSVOC, TPH, P	■	Neither	■	S	■	V	Yes	NA	■
NVOC, NSVOC, TPH	■	Neither	■	None	■	T	Yes	NA	■
HVOC, HSVOC	■	Neither	O	None	■	T	Yes	NA	O
NVOC, TPH HVOC	■	Neither	O	None	■	T	Yes	NA	O
NVOC, NSVOC, TPH	■	Neither	■	None	■	T	Yes	NA	■

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5.0 FIELD SAMPLING PLANS (FSPs)

The FSPs are comprehensive plans prepared for each Investigation Cluster (IC) and other areas to be investigated in Operable Unit (OU) C. The plans will be used to guide field sampling crews through Phase I data collection activities. The plans present a brief history, Phase I data quality objectives, field sampling procedures, sample locations, and analytical methods. All procedures in the FSPs follow those established in the McClellan Quality Assurance Project Plan (QAPP) (Radian, 1992a) and Appendix B of this Sampling and Analysis Plan (SAP).

Each FSP contains a matrix table that summarizes the potential contaminants of concern (COCs), the analytical methods to be used, and the depths for sample collection. (See Section 4.4 for a discussion of how sample depths were determined.) Analytical methods were selected based on the COCs, detection limits required by data users, and the quality of data needed. Analytical methods to be used during Phase I of the investigation are shown in Table 5-1.

Depth intervals for sample collection were based on items described below.

Needs of Each Data User

The needs of all data users were considered in selecting sample depths. For example, health risk assessors require chemical data from the upper 6 inches of soil, whereas soil gas samples from consistent depth intervals (i.e., 15-25', 35-45', 55-65', 75-85', and 90-100' below ground surface [BGS]) are critical to vadose zone modeling, data interpretation, Technical Information System (TIS) modeling, and soil vapor extraction (SVE) remedial action evaluation so that correlations can be made between borings and across locations.

Source Depth

The depth of the source area or discharge point also impacted the planned sample depths. For example, surface samples were not collected in areas where the source is buried below grade or in areas where clean fill has been placed.

Release Mechanisms and Migration Potential of the COCs

The anticipated depth of contaminant migration was considered in selecting sample depths. Factors that govern contaminant movement through soils include the adsorptive capacity of the soil and the affinity of the contaminant for soil particles relative to its solubility in percolating water. Figure 5-1 shows generalized depth intervals used as a guide to determine initial sample depths based on the vertical migration capability of contaminant groups under the generalized subsurface conditions beneath OU C.

Release mechanisms affected sample depth determinations. For example, in areas where historical spills may have occurred, volatile organic compounds (VOCs) and semivolatile organic compounds (SVOCs) in near-surface soil (less than 1 foot) have probably volatilized. Therefore, VOC and SVOC soil samples collected to support a health risk assessment were targeted at 1 foot BGS. Health risk guidelines support use of data from 1 foot BGS in circumstances where samples from 0 to 6 inches would not be representative.

TABLE 5-1. ANALYTICAL METHODS USED IN THE OPERABLE UNIT C REMEDIAL INVESTIGATION

Reference Parameter	Method(s)
Organic Compounds	
Halogenated Volatile Organic Compounds (VOCs)	FGC (soil gas) TO-14 (soil gas) E-18 (soil gas) SW8260 (groundwater) SW8010 (soil and groundwater) SW8240 (soil)
Aromatic VOCs	FGC (soil gas) SW8260 (groundwater) SW8020 (soil and groundwater) SW8240 (soil)
Volatile Petroleum Hydrocarbons	SW5030/8015 Modified
Extractable Petroleum Hydrocarbons	SW3550/8015 Modified
Organochlorine Pesticides and Polychlorinated Biphenyls	SW8080 IPCB
Organic Lead	HML 338
Heavy Petroleum Hydrocarbons	E418.1
Polycyclic Aromatic Hydrocarbons	SW8310
Semivolatile Organic Compounds	SW8270
Dioxins and dibenzofurans	SW8280[a]
Gamma emitters	U.S. EPA 901.1
Alpha and Beta Emitters	SW9310
Inorganic Analytes	
Arsenic	SW7060[b] (soil) SW7060D (dissolved in groundwater)
Chromium VI	U.S. EPA 218.6
Cyanide	SW9012
ICP (Metals)	SW6010[b]
Mercury	SW7471[b] (soil) SW7470D (dissolved in groundwater)
Selenium	SW7740[b] (soil) SW7740D (dissolved in groundwater)
Lead	SW7421D (dissolved in groundwater)

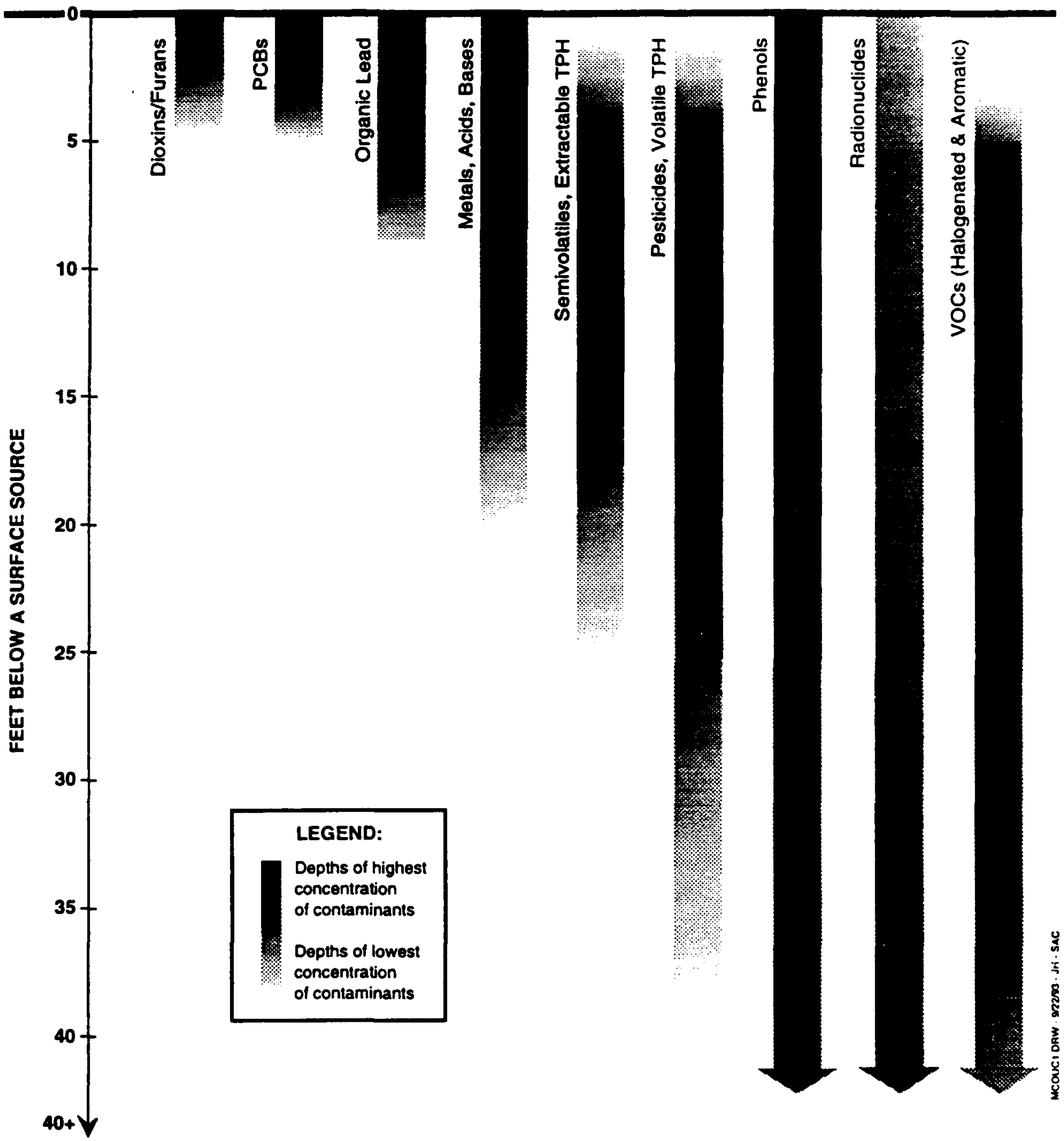
(Continued)

TABLE 5-1. (Continued)

Reference Parameter	Method(s)
Physical Parameters	
Soil pH	SW9045
Bulk Density	ASTM-2937

[a] For toxic and total isomers.
[b] Inorganic methods preceded by SW1311 will be analyzed for soluble metal concentrations.

FGC = Field gas chromatograph.
U.S. EPA = U.S. Environmental Protection Agency.
IPCB = Immunoassay test for PCBs.



NOTE: The presence of multiple contaminant groups in soil may increase the migration potential of the contaminants shown.
Volatilization to the atmosphere beneath a subsurface source would be reduced.
Vertical migration potential estimated from chemical properties in literature.

Figure 5-1. Sampling Depth Intervals for Contaminant Groups

Lithology of the Vadose Zone

Sampling depths identified in the FSPs are not rigid and may change depending on boring-specific lithology and best professional judgment. Thick (greater than 5 feet) and laterally continuous sandy layers will be targeted for soil gas samples. Silty or clayey layers will be targeted for soil sample collection. Guidelines for sample collection (including those for physical parameters in soil) are established in Section 4.4, Field Decisions.

Existing Borings

Existing sample locations are shown in the FSPs. Most of the borings were drilled by McLaren Environmental Engineers and were assigned discrete alphanumeric identifiers to identify the type of boring and its location. For example, 30SAP04 was the fourth SAP-type boring drilled at Confirmed Site 30. Boring types are discussed below.

- Grid Survey Borings (GSB): GSBs were drilled in areas where the lateral extent of buried waste was poorly defined and to verify the presence or absence of buried waste. Borings were drilled to 20 feet BGS or to the top of buried waste — whichever was encountered first. Cuttings were logged and monitored with a photoionization detector (PID) and/or an organic vapor analyzer (OVA).

- Shallow Auger Profile Borings (SAP): SAPs were drilled to 10 or 15 feet BGS as an initial survey to locate contaminated areas. Cuttings were logged and monitored with a PID.

- Deep Auger Profile Borings (DAP): DAPs were drilled on the perimeter of buried waste sites to determine the lateral extent of contamination. Soil was logged and PID readings were taken. Borings were drilled to approximately 60 feet BGS unless waste was encountered or PID readings were positive, in which case the boring was terminated.

- Waste Sample Borings (WSB): These borings were drilled either through buried waste or in surface source areas to collect waste or soil samples for analysis. PID or OVA readings were taken on the cuttings and from the headspace of jarred samples. Waste material was continuously cored. Outside the waste material, samples were collected every 5 feet. Drilling continued until the lower extent of contamination was determined by PID readings and/or visual evidence. All waste samples were sent to an analytical laboratory and composited into one sample for analysis of priority pollutant compounds. A soil sample directly beneath the waste was sent for laboratory analysis of VOCs and any additional COCs. In surface source areas, the sample with the highest probability of containing contaminants (as determined from discolored soil, odors, or PID readings) was sent for analysis of priority pollutant compounds. The bottom sample from the boring was also sent for analysis of VOCs.

- Cased Waste Sample Borings (CWS): CWS borings were drilled through the deepest part of the waste pit to determine the vertical extent of

contamination beneath waste pits. Sampling procedures were similar to those for WSB borings with the following exceptions. The first waste sample was analyzed for VOCs and other COCs. At least one sample beneath the waste was analyzed for priority pollutant compounds and oil and grease. Other samples beneath the waste were analyzed for selected compounds to give an indication of the vertical distribution of contamination. The bottom sample was analyzed for VOCs.

- Soil Sample Borings (SSB): These borings were placed outside the site boundaries to determine the lateral extent of contaminant migration. Headspace readings were taken on samples every 5 feet until extent was determined from the headspace readings. At least one sample was analyzed for VOCs and selected priority pollutants based on the depth of buried waste in the adjacent site and any physical (i.e., PID readings or odors) or visual evidence of contamination. The bottom sample was sent for analysis of VOCs.

Groundwater Sampling

To assist with OU C-wide groundwater decisions, existing OU C A-zone monitoring wells will be sampled during the RI. Representatives from the OU C RI team and the Groundwater OU team will coordinate sampling of the wells for VOCs over a 6-month period during the RI field effort. Monitoring well data, collected under the groundwater OU quarterly monitoring program, will be integrated with OU C RI HydroPunch® data to determine current groundwater conditions in OU C.

Groundwater samples will be collected using a HydroPunch® sampler from all borings drilled to groundwater (see Appendix A). Samples will be analyzed with an on-site gas chromatograph to facilitate field decisions. Duplicate groundwater samples will be sent off site for confirmational analysis. Confirmational analyses will be performed by methods SW8010/SW8020 or SW8260. The most appropriate method is currently under review by members of the Groundwater OU and OU C RI SAP teams and will be determined before the OU C RI is initiated. Some groundwater samples will be analyzed for compounds on the SW8240 analyte list if, on the basis of previous data, ketones are suspected at the location.

All borings drilled to groundwater will be evaluated for conversion to a SVE well, soil vapor monitoring well (SVMW), or groundwater monitoring well (GWMW), or groundwater piezometer (GWPZ). The decision process used is outlined in Section 4.4, Field Decisions, and on Figure 4-9 of this SAP.

Phase I Drilling Procedures

All HydroPunch® and groundwater monitoring well locations will be drilled first. The groundwater data will be used to identify potential source areas of contamination and fill data gaps on contaminant migration and flow directions. Subsequent sampling locations may be changed based on the groundwater data.

Borings drilled through known pits and landfills will be cased to at least 10 feet below the bottom of the disturbed soil. The bottom

In Phase I of the OU C RI, borings will be drilled using at least two different types of drill rigs. Each rig has specific applications where it is the most efficient and cost-effective method. The rig types which may be used during the RI are discussed below.

A cone penetrometer (CPT) drill rig can be used to collect rapid analytical and lithologic data without generating cuttings for disposal. This method has been successfully demonstrated at McClellan Air Force Base (AFB), but has not been applied in an RI. Soils at McClellan AFB contain layers of hardpan, which are difficult for the CPT rig to penetrate; therefore, the rig may have limited success at some locations. A CPT rig will not be used in areas where visual evidence of soil disturbance or contamination is required or for installation of monitoring wells or piezometers.

A sonication drill rig can be used to obtain continuous core for visual observations of physical features in soil. Cuttings are not generated using this method. A sonication rig may be used to install conductor casing through waste pits or perched water in vertical borings and those drilled at an angle. The rig cannot, however, be used to install monitoring wells or piezometers — the technology has not been developed.

A hollow stem auger (HSA) drill rig can also be used to obtain continuous core for visual observations of physical features in soil. This method generates soil cuttings which must be drummed and properly disposed. An HSA rig may be used to install conductor casing in vertical borings drilled through waste pits or in areas where perched water is encountered. It can also be used to install monitoring wells and piezometers.

The following subsections contain the location-specific FSPs for the OU C RI. The areas to be investigated and the sample locations proposed are shown on Plate 1. Plate 1 also indicates which matrices (i.e., soil, soil gas, and/or groundwater) will be sampled in each boring. Plate 2 includes the recommended drilling method for the proposed boring locations. Table 5-2 provides a cross reference between ICs, areas under investigation, and the FSP section in which they are located. A list of acronyms used is provided in the front of the report.

TABLE 5-2. CROSS REFERENCE AMONG ICs, PRLs, AND OTHER LOCATIONS

SAP Section	ICs or Other Locations	CSs, PRLs, and Other Locations	WIMS ID Number[a]
5.1	IC 9	PRL S-31	SD116
		PRL S-32	SS117
		PRL 65	LF061
		Magpie Creek	SD165
5.2	IC 10	PRL S-11	SS096
		Tank 6008	—
		Aero Club	—
5.3	IC 11	PRL 32	SS032
		PRL 56	SS054
		PRL 57	LF055
		Tank 737	—
		Magpie Creek	SD165
5.4	IC 12	PRL S-48	OT168
		PRL 66A	WP062
		PRL L-7A	OT164
5.5	IC 13	PRL 18	LF018
		PRL 19	LF019
		PRL 54	SS052
		PRL 55	SS053
		Former Gas Station	—
		Former Magpie Creek Channel	SD165
5.6	IC 14	PRL L-7B	OT164
		PRL 17	LF017
		PRL 20	DP020
		PRL 21	DP021
		PRL 63	SD059
		PRL 64	SD060
		PRL 66B	WP062
		Tank 714	—
		Free Oil Tank	—
5.7	IC 15	PRL P-10	SD165
		PRL 28	DP028
		PRL 60	WP056
5.8	IC 16	PRL 50	WP048
		PRL 51	WP049

(Continued)

TABLE 5-2. (Continued)

SAP Section	ICs or Other Locations	CSs, PRLs, and Other Locations	WIMS ID Number[a]
5.9	IC 17	CS 43	LF043
		CS 52	DP050
		CS 67	WP063
		PRL 15	DP015
		PRL 16	DP016
		Don Julio Creek	—
		Tank 702	—
		Drainage Ditch	—
5.10	IC 18	PRL L-7C	OT164
		PRL 49	LF047
		PRL 66C	WP062
		Drainage Ditch	—
5.11	IC 19	CS 10	LF010
		CS 11	LF011
		CS 12	LF012
		CS 13	LF013
		CS 14	LF014
		Fire Training Area	—
		Contaminated Soils Holding Area	—
		Don Julio Creek	—
		Drainage Ditch	—
5.12	IC 20	PRL L-7D	OT164
		PRL 9	LF009
		PRL S-46	OT166
		PRL 66D	WP062
		Drainage Ditch	—
5.13	IC 21	CS 7	SD007
		PRL 8	LF008
		Tank 701	—
		Tank 712	—
		Small Arms Firing Range	—
5.14	PRL 53	PRL 53	WP051
		Former Firing Range	—
		Don Julio Creek	—
		IWL	—
5.15	PRL S-10	PRL S-10	SS095
5.16	Tank 761	Tank 761	—
5.17	Tanks 783 and 788	Tank 783	—
		Tank 788	—

NOTE: All acronyms are defined in the acronym list at the beginning of the SAP.

5.1 Field Sampling Plan for Investigation Cluster (IC) 9 (Potential Release Location [PRL] 65, PRL S-31, PRL S-32, and Magpie Creek)

Investigation Cluster 9 comprises PRL 65, PRL S-31, PRL S-32, and a portion of Magpie Creek (Figure 5.1-1). The IC is located in the south eastern portion of Operable Unit (OU) C.

Potential Release Location 65 is visible as a surface disturbance in aerial photographs from 1940s to the 1960s. In a 1966 aerial photograph, three oblong areas 300 feet long by 150 feet wide were identified where hazardous waste may have been disposed (CH2M HILL, 1993). Portions of this area are currently covered by an open storage lot (PRL S-32) and part of Magpie Creek.

Potential Release Location S-31 is Building 692, an aircraft hangar used for aircraft painting, paint removal, and corrosion control coating. The 54,000-square-foot building was constructed in 1968 and has been in operation since that time. Building 691, east of PRL S-31, is a bead blasting operation used to prepare aircraft for coatings applied in Building 692. Building 691 can be identified for the first time in a 1987 aerial photograph and is approximately 100 feet square. The asphalt southwest of Building 691 is stained with paint.

Wastewater generated in Building 692 was discharged to the Industrial Wastewater Line (IWL) until 1993 when discharge reportedly exceeded the maximum allowable levels of certain contaminants. Currently, wastewater is pumped to an open-topped aboveground tank west of the building. This tank reportedly overflowed at its northwest corner twice in 1993 during heavy rains.

During the OU B Soil Gas Investigation and the OU B RI, two soil gas probes (to 6 feet below ground surface [BGS]) and five borings (one drilled to 20 feet BGS along the IWL and one drilled to groundwater in PRL S-32) were drilled in IC 9. Results (Table 5.1-1) indicate VOCs up to 1,500 parts per billion by volume (ppbv) in the soil gas along the IWL at 20 feet BGS (Radian, forthcoming). Concentrations were lower in the PRL S-32 boring. The groundwater samples from PRL S-32 contained trichloroethene and cis-1,2-dichloroethene above maximum contaminant levels. The source of this groundwater contamination is unknown.

Potential Release Location S-32 consists of Building 694, a covered and fenced area used for hazardous materials and waste storage, and an uncovered hazardous waste storage yard. Wastes are temporarily staged on the open lot and in the southern portion of Building 694 prior to delivery to the Defense Reutilization Management Office (DRMO) in OU B. The northern portion of Building 694 is used to store hazardous materials used in Buildings 691 and 692.

Building 694 was constructed in 1970. The area is bermed. The open lot is also bermed and contains five storage buildings and a trailer (office). Four of the buildings have been used to store specific types of wastes (Figure 5.1-1). Two storm drains are located within PRL S-32, and a third is located to the north in PRL 65; all of these drains discharge to Magpie Creek, but have emergency shut-off valves to block flow if a spill occurs. The drains in PRL S-32 are normally left shut. The drain in PRL 65 is normally left open and receives surface water runoff from the surrounding field.

Approximately 900 linear feet of Magpie Creek runs through IC 9. The creek was redirected to its current alignment in the 1960s. The previous alignment of Magpie Creek also ran through IC 9. Numerous outfalls discharge into Magpie Creek. The creek is unlined until it reaches Building 692; from there on, it is lined with Gunite® and steel. Sediment samples collected near an upstream section of Magpie Creek by McClellan Air Force Base (AFB) Environmental Management (EM) were reported to contain polycyclic aromatic hydrocarbons (PAHs) up to 1,650 μg/kg. The discharge point for this contamination is unknown.

A portion of Apron 7618 is located in the southeast corner of IC 9. Soil between the blast fence and the southwest corner of Apron 7618 appears to be stained in aerial photographs from 1973 to 1991. This area will also be investigated as part of IC 9.

Previous investigations conducted at IC 9 are summarized in Table 5.1-1.

5.1.1 Data Quality Objectives

The data quality objective for this phase of the Remedial Investigation (RI) at IC 9 are shown on Table 5.1-2.

5.1.2 Sampling Plan

Proposed sampling locations are shown on Figure 5.1-2. Overlay A shows previous sampling locations. Potential contaminants of concern and the sampling and analytical matrix for IC 9 are shown in Table 5.1-3; field specifications for sampling locations are included in Table 5.1-4.

Rationale and specific objectives for sampling locations are outlined below.

Six borings (SB1 through SB6) and two hand augers (HA1 and HA18) will be drilled and sampled around the perimeter of Building 692 (PRL S-31) and north of Building 691 to determine if any discharges from painting, coating and stripping operations have contaminated the subsurface. The hand auger (HA1) will be drilled at the northwest corner of the aboveground wastewater tank to characterize any subsurface contamination where the tank overflowed.

Two borings and four hand augers will be drilled and sampled in and around PRL S-32 to determine if spills and/or leaks of contaminants stored at the location have contaminated surface soils and/or soil gas. Boring SB7 and hand auger HA2 will be placed adjacent to the two storm drains—the lowest topographic points at PRL S-32 to which surface spills or runoff would flow. Boring SB8 and hand augers HA3, HA4, and HA5 will be drilled at entrances to the hazardous waste storage area where spills may have occurred. Contaminants of concern in PRL S-32 include volatile and semivolatile organic compounds, inorganic species, polychlorinated biphenyls (PCBs), dioxins/furans, petroleum hydrocarbons, acids, bases, and cyanide due to the wide variety of chemicals stored at this location. Samples will be analyzed for dioxins/furans only if PCB results from the same depth interval are positive.

Analytical results from two borings (SB9 and SB10) and three hand augers (HA6 through HA8) in PRL 65 will help indicate if hazardous waste disposal has contaminated the subsurface. Boring SB9 will be placed adjacent to the storm drain in PRL 65, which collects surface water run-off.

Seven stream sediment samples (MC1 and HA12 through HA17) will be collected

and analyzed to determine if creek sediments are contaminated. Samples will be collected where each of the storm drains discharge to Magpie Creek. Hand auger HA17 is located in the area where PAHs were previously detected by McClellan AFB in 1987 (see Table 5.1-1). Both HA17 and HA16, downstream of HA17, will be analyzed for PAHs. Surface samples will be composited in areas where the creek is lined (MC1). Hand auger samples will be collected at approximately 3 inches and 5 feet BGS where the creek is unlined.

A trench will be dug to locate the former Magpie Creek channel. Samples will be collected at the former creek bed surface and 3 feet below the surface to determine if sediments are contaminated.

Two hand augers (HA10 and HA11) will be placed along the west and south side of Apron 7618. Soil results will help determine if the stains identified in aerial photographs are the result of soil contamination.

Physical parameter samples will be collected from two soil types in Boring SB4 to provide information for vadose zone modeling and for evaluation of remedial alternatives.

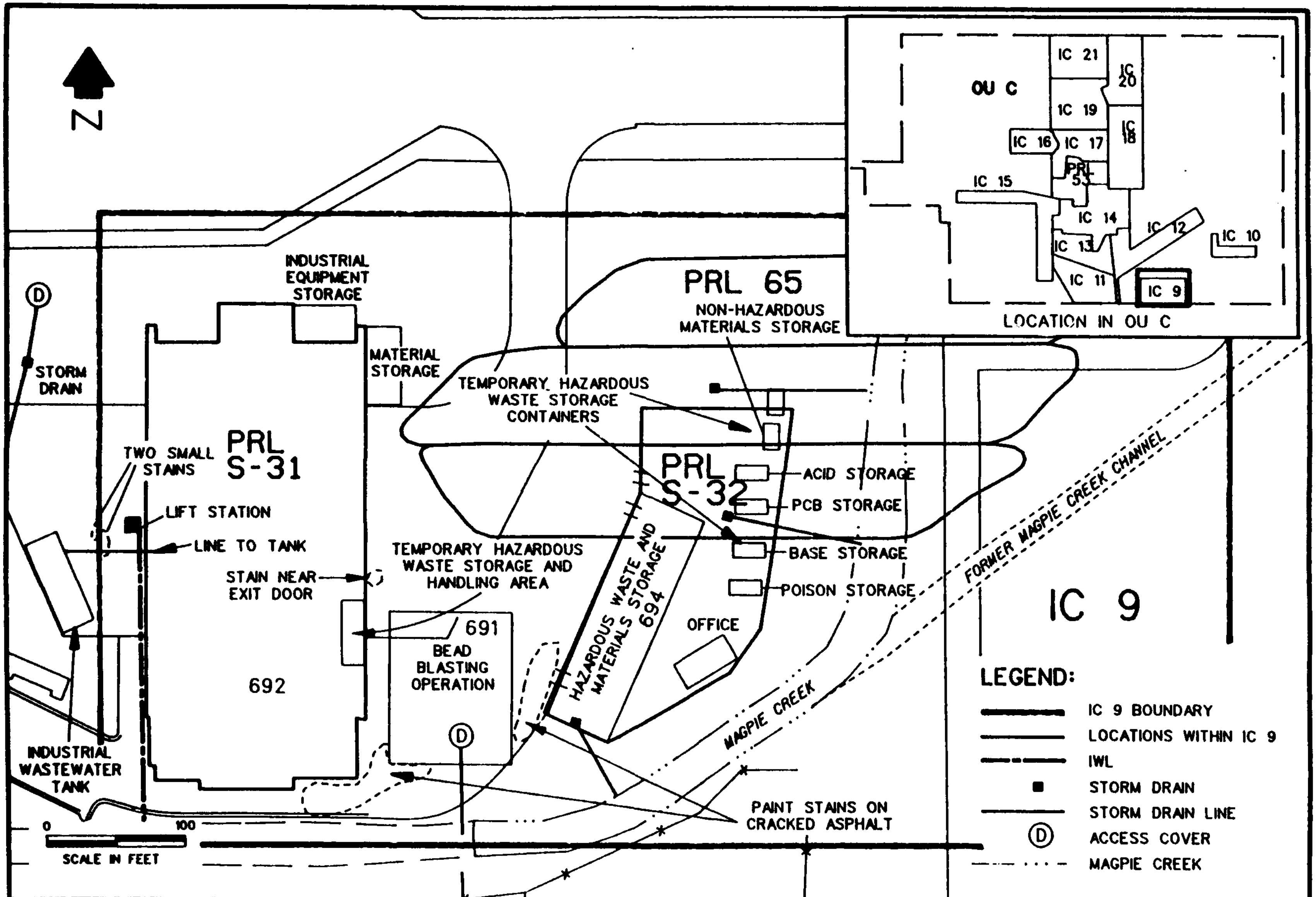


Figure 5.1-1 Potential Discharge Areas in IC 9

OUC4 IC9PDA SAC 2/23/94

TABLE 5.1-1. PREVIOUS INVESTIGATIONS AT IC 9

Year, Contractor	Scope of Investigations	Key Findings
1985, McLaren Environmental Engineers	Investigation of potential contamination at PRL 65, PRL S-31, and PRL S-32. A total of four borings were drilled and sampled at PRL 65.	HNu® readings of up to 100 ppm were reported in the headspace (soil gas). Disturbed soil to 8 feet BGS was encountered in two borings.
1987, McClellan AFB	Two soil samples were collected at Building 692.	Low levels (<50 μg/kg) of HVOCs and SVOCs. Silver, mercury, and lead reported above subsurface background. Sample locations are unknown.
1987, McClellan AFB	Sediment samples were collected in Magpie Creek near the northwest corner of Building 651 (refer to Figure 5.1-2).	PAHs were reported in one sample at concentrations >1,600 μg/kg. The exact location of these samples could not be determined.
1988, McClellan AFB	Nine locations at PRL S-32 were sampled from 4 to 20 feet BGS.	Low-level AVOCs and HVOCs were reported in soil. Contamination was not widespread. Sample locations are unknown.
1991, Radian Corporation	Near-surface soil gas investigation. Two probes placed in IC 9 of OU C.	VOCs were reported at concentrations less than 100 ppbv.
1992 and 1993, Radian Corporation	OU B RI at IC 3. Four borings were drilled and sampled in IC 9 along the west side of Building 692 along the IWL. One boring was drilled and sampled at IC 9 in the southern portion of PRL S-32.	AVOCs were reported in soil gas at concentrations <1,500 ppbv in one boring along the IWL. UVOCs were reported less than 500 ppbv in another boring along the IWL. In PRL S-32, AVOCs, HVOCs, and UVOCs were reported in soil gas at less than 250, 500, and 850 ppbv, respectively.
1993, CH2M HILL	Preliminary Assessment of sites and locations in OU C.	Identified areas to be investigated in OU C through records review, site visits, and interviews with base personnel.

NOTE: All acronyms are defined in the acronym list at the beginning of the SAP.

TABLE 5.1-2. DATA QUALITY OBJECTIVES FOR PRL S-31

Problem Statement Hazardous materials are used for operations in PRL S-31 (Building 692) and may have spilled or leaked into the subsurface.
Decision to be Made • Determine if operations in Building 692 have contaminated the surface and/or subsurface. • Determine the location priority.
Inputs to the Decision Level II/III for VOCs in soil gas; Level III for SVOCs and inorganics in soil.
Boundaries of the Study Soil gas samples from approximately 20 to 40 feet BGS will be collected around the perimeter of Building 692. Soil samples collected from 0.25 to 5 feet BGS.
Decision Rule • If VOCs are reported in soil gas at PRL S-31, and if concentrations decrease with distance from the location horizontally, then VOC contamination most likely originates at the location. • If inorganics are reported above background concentrations in surface soil samples, then spills or leaks at PRL S-31 may have contaminated the location and the decision process for inorganics should be applied. • If all data collected are validated, proceed to Data Evaluation DQOs (see Section 4.2.2).
Limits on Uncertainty Analytical data must meet project specifications for precision and accuracy.
Sample Design Soil gas borings SB1–SB6 will be drilled around perimeter of Building 692 at approximately 100-foot intervals from each other and existing borings. Hand augers will be placed next to overflow location at the aboveground storage tank (H1) and in the area of a large surface paint stain (H18).

(Continued)

TABLE 5.1-2. (Continued)

DATA QUALITY OBJECTIVES FOR PRL S-32

Problem Statement Hazardous materials and wastes are stored at PRL S-32 and may have spilled or leaked from the storage area contaminating the subsurface and nearby Magpie Creek.
Decision to be Made • Determine if the subsurface is contaminated. • Determine the location priority.
Inputs to the Decision Level II/III for VOCs in soil gas; Level III for SVOCs, PCBs, and/or inorganics in soil and stream sediment.
Boundaries of the Study Soil gas samples from approximately 20 to 40 feet BGS will be collected at PRL S-32. Soil samples will be collected from surface to 5 feet BGS.
Decision Rule • If organic compounds are reported in soil and/or soil gas collected at PRL S-32, then the subsurface has most likely been contaminated by spills or leaks of materials stored at the site. • If inorganics are reported above background concentrations in surface soil samples, then spills or leaks at PRL S-32 may have contaminated the location and the decision process for inorganics should be applied. • If all data collected are validated, proceed to Data Evaluation DQOs (see Section 4.2.2).
Limits on Uncertainty Analytical data must meet project specifications for precision and accuracy.
Sample Design Hand augers H3–H5 will be placed adjacent to each entrance/exit to the storage facility. Boring SB8 will be drilled adjacent to the main gate. Boring SB7 will be drilled next to a storm sewer drain in the open storage area. Hand auger HA2 will be drilled adjacent to the drain at the southern end of Building 694.

(Continued)

TABLE 5.1-2. (Continued)

DATA QUALITY OBJECTIVES FOR PRL 65

Problem Statement

If hazardous materials were disposed at PRL 65, the location may be contaminated.

Decision to be Made

- Determine if hazardous waste has been disposed of at PRL 65 and contaminated the subsurface.
- Determine the location priority.

Inputs to the Decision

Level II/III for VOCs in soil gas; Level III for SVOCs, PCBs, and/or inorganics in soil.

Boundaries of the Study

Soil gas samples from approximately 20 feet BGS will be collected at PRL 65. Soil samples will be collected from surface to 5 feet BGS.

Decision Rule

- If organic compounds are reported in soil and/or soil gas samples, then the subsurface is contaminated.
- If inorganics are reported above background concentrations in soil samples, then soils at PRL 65 may have been contaminated by hazardous waste disposal and the decision process for inorganics should be applied.
- If all data collected are validated, then apply Data Evaluation DQOs (see Section 4.2.2).

Limits on Uncertainty

Analytical data must meet project specifications for precision and accuracy.

Sample Design

Hand augers HA6–HA8 and Borings SB9 and SB10 will be drilled to determine if surface and near-surface soils are contaminated. Soil gas from SB9 and SB10 will help determine if VOCs were disposed within the boundaries of PRL 65. Boring SB9 is located adjacent to the storm drain which collects surface run-off in the area.

(Continued)

TABLE 5.1-2. (Continued)

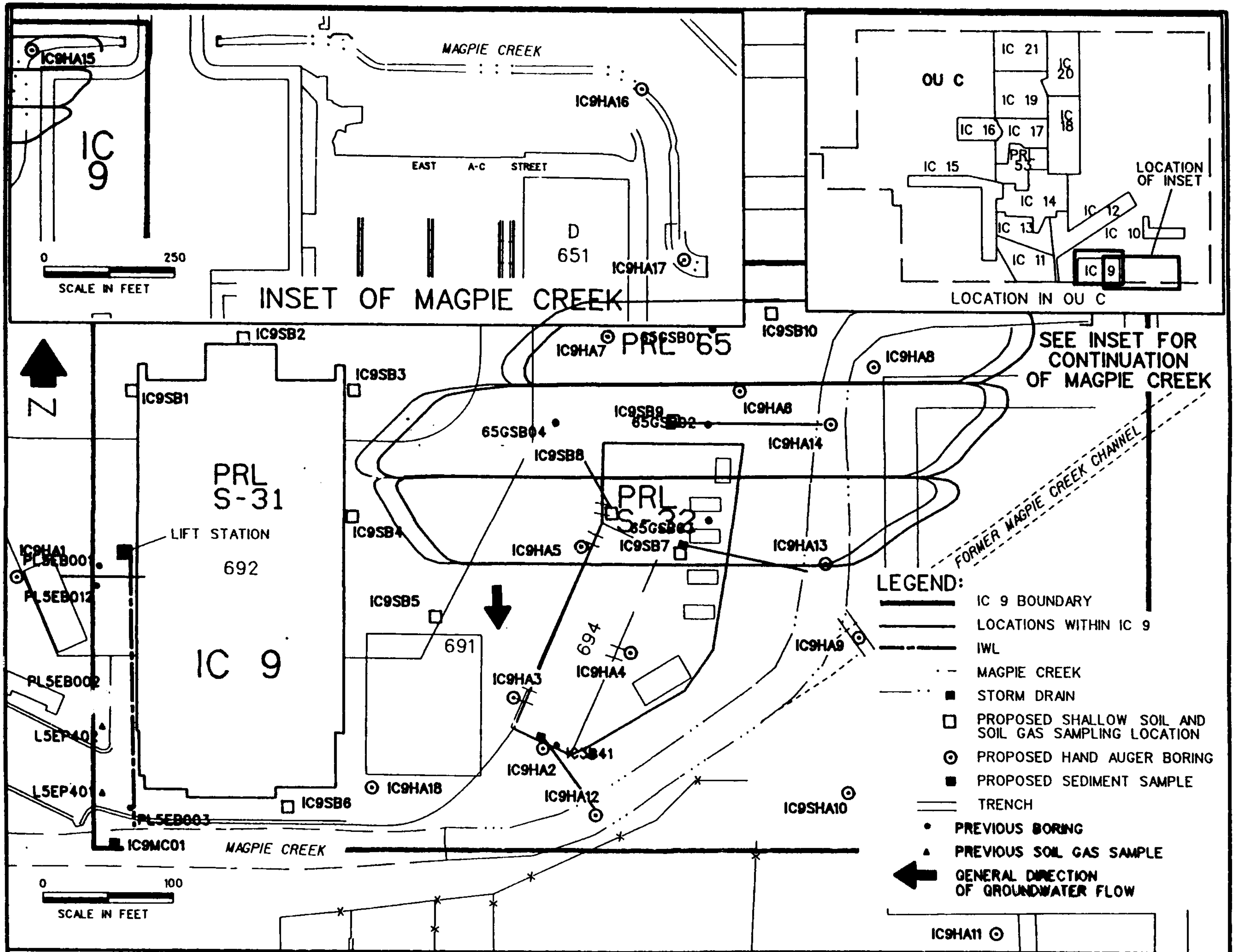
DATA QUALITY OBJECTIVES FOR MAGPIE CREEK

Problem Statement Contaminants discharged to Magpie Creek may have contaminated the sediments and the subsurface.
Decision to be Made • Determine if organic or inorganic species have contaminated the creek sediments. • Determine the location priority.
Inputs to the Decision Level III data for organic and inorganic species in soil.
Boundaries of the Study Soil samples will be collected from sediments within the active creek and former creek channels.
Decision Rule • If organic compounds are reported, sediments or soil are contaminated. • If inorganics species are reported above background concentrations, the sediments may be contaminated and the decision process for inorganic species should be applied. • If all data collected are validated, then apply Data Evaluation DQOs (see Section 4.2.2).
Limits on Uncertainty Analytical data must meet project specifications for precision and accuracy.
Sample Design Samples from HA12–HA14 will be collected at outfalls. Hand augers HA15–HA17 will be drilled at sediment deposition points upstream of IC 9. HA17 is also located in the area where PAHs were previously reported. HA16, downstream of HA17, will also be analyzed for PAHs. The sediment sample from location MC1 will be composited since this area of the creek is lined. Hand auger HA9 is located in the former Magpie Creek channel.

TABLE 5.1-2. (Continued)

DATA QUALITY OBJECTIVES FOR APRON 7168

Problem Statement Surface stains were observed between Apron 7168 and aircraft blast fences.
Decision to be Made • Determine if soil is contaminated. • Determine the location priority.
Inputs to the Decision Level III for SVOCs, TPH, and/or inorganics in soil.
Boundaries of the Study Soil samples will be collected from surface to 5 feet BGS.
Decision Rule • If organic compounds are reported in soil, then the subsurface is contaminated. • If inorganics are reported above background concentrations in surface soil samples, then the area may be contaminated and the decision process for inorganics should be applied. • If all data collected are validated, proceed to Data Evaluation DQOs (see Section 4.2.2).
Limits on Uncertainty Analytical data must meet project specifications for precision and accuracy.
Sample Design Hand auger samples HA10 and HA11 will be collected in areas where soil staining was identified from aerial photos.



Overlay A. Previous Sampling Locations

Figure 5.1-2 Proposed Sampling Locations in IC 9

OUC4 IC9PSL SAC 2/24/94

TABLE 5.1-3. SAMPLING AND ANALYSIS MATRIX FOR IC 9

Location:	PRL S-31			PRL S-32		PRL 65	
Potential Contaminants of Concern:	VOCs, SVOCs, Inorganic species		VOCs, SVOCs, Inorganic species, PCBs, Dioxins/furans, TPH, Acids, Bases			VOCs, SVOCs, Inorganic species	
Sampling Location:	Borings SB1–SB4[a], SB5–SB6	Hand Auger HA1	Hand Auger HA18	Boring SB7[a]	Hand Augers HA2–HA4	Borings SB8–SB10	Hand Augers HA5–HA8
Sample Depth and Analytical Method:	(0–0.25') SW6010 (1') SW8270 (15–25') FGC (35–45') FGC	(0–0.25') SW6010 (1') SW8270 SW8240 (5') SW6010, SW8270, SW8240	(0–0.25) SW6010 (1') SW8270 (5') SW6010, SW8270	(0–0.25') SW6010, SW9012, SW8270, SW8080, SW9045, ModSW8015/3550, SW8280[b] (1') SW8270 (5') SW6010, SW9012, SW8270, SW8080, SW9045, ModSW8015/3550, ModSW8015/5030, SW8280[b] (15–25') FGC (35–45') FGC	(0–0.25') SW9012, SW8080, SW8280[b], SW9045, ModSW8015/3550, SW6010 (1') SW8270 (5') SW9012, SW8270, SW8080, SW9045, ModSW8015/3550, ModSW8015/5030, SW8280[b]	(0–0.25') SW6010 (1') SW8270 (5') SW6010, SW8270 (15–25') FGC	(0–0.25') SW6010 (1') SW8270 (5') SW6010, SW8270

(Continued)

TABLE 5.1-3. (Continued)

Location:	Magpie Creek				Apron 7168
Potential Contaminants of Concern:	SVOCs, Inorganic species, TPH				SVOCs, TPH, Inorganic species
Sampling Location:	Sediment Sample MC1	Sediment Samples HA12-HA15	Sediment Samples HA16 and HA17	Hand Auger HA9	Hand Augers HA10, HA11
Sample Depth and Analytical Method:	(0-0.25') ModSW8015/3550, SW6010	(0-0.25') ModSW8015/3550, SW6010 (1') SW8270 (5') ModSW8015/3550, SW6010, SW8270	(0-0.25) ModSW8015/3550, SW6010, SW8310 (1') SW8270 (5') ModSW8015/3550, SW6010, SW8270, SW8310	(creek bed surface) SW6010, SW8270, ModSW8015/3550 (3' below creek bed) ModSW8015/3550, SW8270, SW6010	(0-0.25') SW6010, ModSW8015/3550 (1') SW8270 (5') SW6010, ModSW8015/3550, ModSW8015/5030, SW8270

[a] Two samples will be collected in different soil types in each boring (SB4 and SB7) for bulk density analysis (ASTM 2937).
[b] Samples will be analyzed by SW8280 (dioxins/furans) only if PCBs are detected in the same sample interval. Samples will be held by the laboratory pending results.

FGC = Screening analysis of soil gas for commonly detected VOCs with an on-site chromatograph.

NOTE: Matrix represents the minimum number of samples to be collected in each horizon.
FGC analyses will be confirmed with 10% TO-14 analyses.
Specific sample depths will be determined in the field using the sampling criteria specified in Section 4.
All acronyms are defined on the acronym list in the beginning of the SAP.

TABLE 5.1-4. SAMPLING AND FIELD SPECIFICATIONS FOR IC 9

Boring/Location Name	Reference Point	Distance	Maximum Depth Interval (ft BGS)
Hand Augers			
HA1	Southwest corner of Bldg. 692	158'N, 98'W	5
HA2	Southeast corner of Bldg. 694	5'N, 20'W	5
HA3	Northwest corner of Bldg. 694	132'S, 132'W	5
HA4	Southeast corner of Bldg. 694	77'N, 46'E	5
HA5	Northwest corner of Bldg. 694	17'S, 16'W	5
HA6	Northwest corner of Bldg. 694	101'N, 106'E	5
HA7	Northwest corner of Bldg. 694	141'N, 4'E	5
HA8	Northeast corner of PRL S-32 fence	59'N, 100'E	5
HA9	Northeast corner of PRL S-32 fence	146'S, 88'E	3
HA10	Northwest corner of Bldg. 690	193'N, 161'W	5
HA11	Northwest corner of Bldg. 690	86'N, 46'W	5
HA12	Southeast corner of Bldg. 694	44'S, 19'E	5
HA13	Northwest corner of Bldg. 694	30'S, 171'E	5
HA14	Northeast corner of PRL S-32 fence	15'N, 67'E	5
HA15	Southeast corner of Bldg. 694	318'N, 224'E	5
HA16	Northeast corner of Bldg. 651	153'S, 116'E	5
HA17	Northeast corner of Bldg. 651	176'N, 23'E	5
HA18	Southwest corner of Bldg. 691	3'S, 1'E	5
Sediment Sample			
MC1	Southwest corner of Bldg. 692	41'S, 23'W	0.25
Borings			
SB1	Northwest corner of Bldg. 692	19'S, 4'W	45
SB2	Northwest corner of Bldg. 692	20'N, 80'E	45
SB3	Northeast corner of Bldg. 692	8'S, 6'E	45
SB4	Northeast corner of Bldg. 692	112'S, 6'E	45
SB5	Northeast corner of Bldg. 692	189'S, 69'E	45
SB6	Southwest corner of Bldg. 692	9'S, 53'E	45
SB7	Northwest corner of Bldg. 694	22'S, 60'E	45
SB8	Northwest corner of Bldg. 694	3'N, 204'E	25
SB9	Northwest corner of Bldg. 694	79'N, 56'E	25
SB10	Northwest corner of Bldg. 694	160'N, 131'E	25

5.2 Field Sampling Plan for Investigation Cluster (IC) 10 (Potential Release Location [PRL] S-11 and Tank 6008)

Investigation Cluster 10 comprises PRL S-11, Building 635, and Tank 6008 (Figure 5.2-1). The IC is located in the southeastern portion of Operable Unit (OU) C.

Potential Release Location S-11 includes Buildings 636 and 637, and the area surrounding Building 637. Building 636, constructed in 1956, is a 120-foot by 50-foot metal building with concrete floors. The building was used for generator repair from 1956 to 1980. It was also used to store PCB wastes, transformers containing PCB oil, and fire department suppression materials. If spills occurred inside the building, any contaminants that were washed off the concrete floor could have been transported, through the gap between the floor and metal walls, to soil outside the building. A bermed PCB storage area in Building 636 was not built until sometime after 1978. Historical records document a PCB spill, leaking drums containing PCB liquids, and a phenolic spill at PRL S-11.

Building 637, east of Building 636, was most likely used to store equipment, tools, and materials for generator repair activities. The area around Building 637 was used as a maintenance yard for generator repair from 1956 to 1980. A 1976 historical photograph shows stained soil east and south of Building 637. This area of stained soil was later paved over with concrete. During Radian's 1993 site visit, two stains were noticed on the concrete (also identified in the 1976 historical photograph) north of Building 637, and stains were observed on the floor of Building 636. Potential Release Location S-11 has been characterized as a very "dirty" operation (Jeffrey, 1993) and the area east of Building 636 as being "oily" (CH2M HILL, 1993). Potential contaminant discharge points/areas and areas of stained soil are identified in Figure 5.2-1.

Building 635 is currently the location of the McClellan Air Force Base (AFB) Aero Club. Prior to its current use, Building 635 was used by the Fire Department as one of the McClellan AFB fire stations. A 1962 historical photograph shows the area east of Building 635 being used for equipment storage. The Aero Club has occupied the building since 1983; the club's activities have increased from operation of six aircraft in 1983 to approximately double that number currently. Two 5,000-gallon aboveground storage tanks containing aviation gas are located just north of the building. Aircraft are cleaned and maintained on the east side of the building. Past practices in this area included a solvent washdown of the aircraft's engine (Duvall, 1994).

Tank 6008 was a 900-gallon underground storage tank (UST) located east of PRL S-11. The tank was adjacent to a Glide Slope that provides electronic signals to aircraft. Tank 6008 most likely supplied diesel fuel to a backup generator for Glide Slope electronics. The tank was 47 inches in diameter and 10 feet long. It is unknown when the tank was installed; however, it passed leak testing in October 1986 and was removed in 1988.

Previous investigations of IC 10 are summarized in Table 5.2-1.

5.2.1 Data Quality Objectives

The data quality objectives for this phase of the Remedial Investigation (RI) at IC 10 are shown on Table 5.2-2.

5.2.2 Sampling Plan

Proposed sampling locations are shown on Figures 5.2-2 and 5.2-3. Potential contaminants of concern and the sampling and analytical matrix for IC 10 are shown in Table 5.2-3; field specifications for sampling locations are included in Table 5.2-4.

Rationale and specific objectives for sampling locations are outlined below.

Six borings (SB1 through SB6) will be drilled at PRL S-11 to characterize subsurface contamination. Borings will be located in areas of stained soil identified in historical photographs and around the perimeter of Building 636.

Six hand augers (HA1 through HA6) will be drilled and sampled to determine if surface soils are contaminated. The hand augers will be located in areas of stained soil identified in historical photographs and near Building 636. Near surface samples (less than 0.25 feet below ground surface) will be analyzed using an immunoassay field test kit to determine whether PCBs spilled, leaked, or washed into the soil from Building 636.

At least three hand augers (HA12 through HA14) will be placed in areas where immunoassay results are 5 milligrams per kilogram (mg/kg) or greater. Highest PCB contamination indicated by immunoassay results to confirm the screening results, determine the vertical extent of contamination that is 50% or more of the likely cleanup goal of 10 mg/kg, and determine if dioxins and/or furans are present at these locations. The extent will be defined to 3 feet BGS.

Three hand augers (HA7 through HA9) will be sampled in the drainage ditch that may have carried contaminated surface water from PRL S-11. Each surface scrape sample will be composited 5:1 from a 10-foot diameter area around the center of the drainage. Two of the hand augers will be located where surface run-off enters the swale near the upper end of the drainage path. The third hand auger will be located in the drainage at its confluence with an east/west trending ditch.

One shallow boring (SB7) and two hand augers (HA10 and HA11) will be drilled and sampled to investigate possible contamination at Building 635. The shallow boring will be placed on the east side of Building 635 to determine if solvents used to wash aircraft engines contaminated the subsurface. The two hand augers will be located adjacent to dispensing nozzles on the aboveground tanks to determine if leaks or spills may have occurred.

A record search of Civil Engineering construction diagrams will be conducted to determine the former location of Tank 6008. Boring SB8 will be drilled adjacent to the former tank location to determine if diesel fuel has contaminated the subsurface. Soil gas samples will also be collected to determine if other compounds are present that may affect remediation decisions.

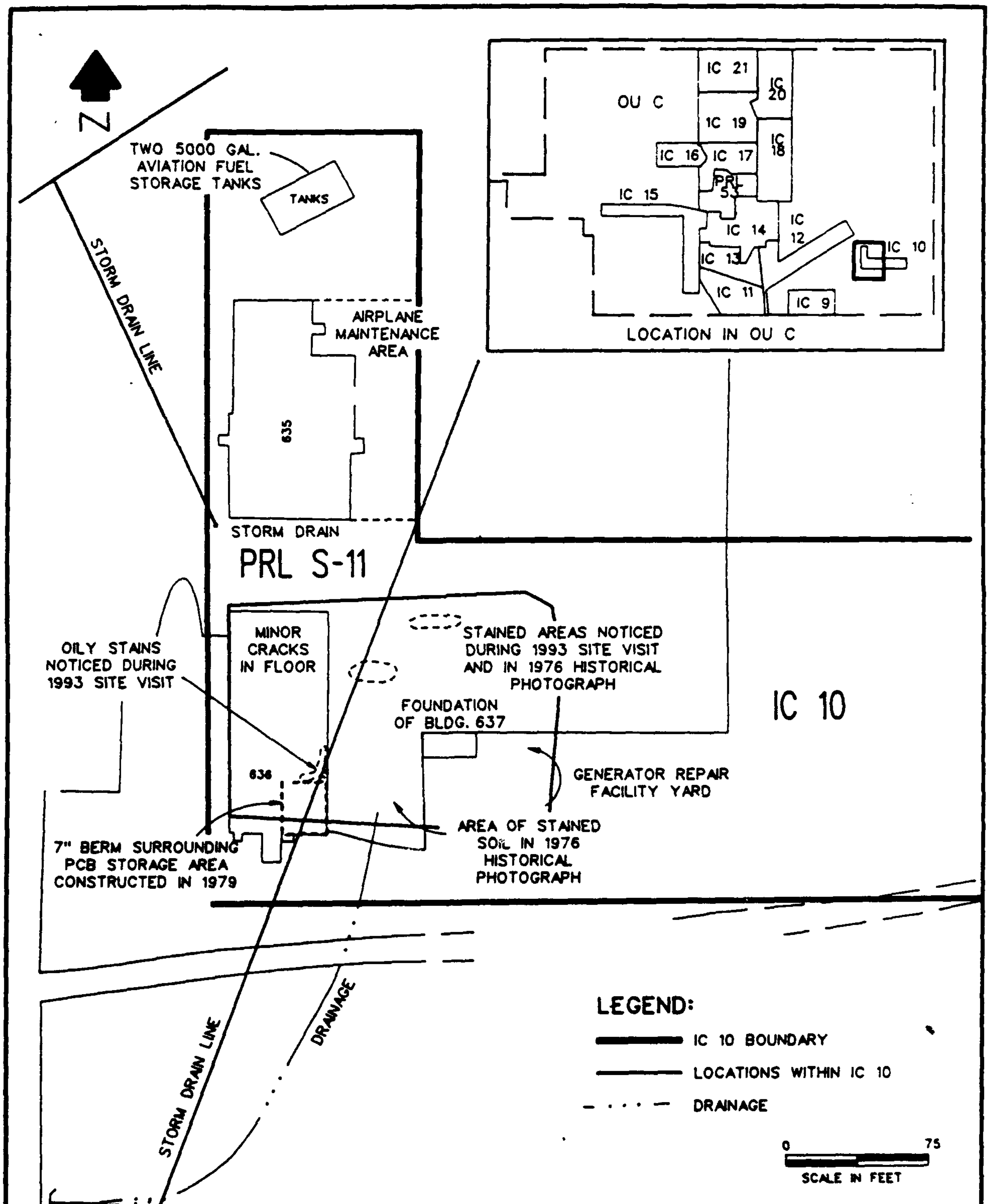


Figure 5.2-1 Potential Discharge Areas at IC 10

OUC4 IC10PDA2 SAC 2/23/94

TABLE 5.2-1. PREVIOUS INVESTIGATIONS AT IC 10

Year, Contractor	Scope of Investigation	Key Findings
1980, McClellan AFB	In-house inspection of drum storage inside Building 636.	52 drums contained liquid waste and 38 drums contained solid waste. Seven leaking drums and four over-filled drums were identified.
1980, McClellan AFB	All 52 liquid waste drums identified in the investigation above were tested for PCBs.	Six drums contained PCBs < 50 ppm. One drum contained PCB 50–500 ppm. Forty-five drums contained 100% PCBs. The seven leaking drums ranged between 40,000 and 1,000,000 ppm of PCBs. The four overfilled drums ranged between 44,000 and 840,000 ppm.
1989, Radian Corporation	Preliminary assessment of sites and potential release locations in OU C.	Designated Building 636 and area to the east as unstudied PRL (UPRL) S-11.
1992, CH2M HILL	Preliminary assessment of sites and potential release locations in OU C.	Identified areas to be investigated in OU C through records review, site visits, and interviews with base personnel.

NOTE: Acronyms are defined in the acronym list at the beginning of this SAP.

TABLE 5.2-2. DATA QUALITY OBJECTIVES FOR PRL S-11

Problem Statement PCBs stored at PRL S-11 may have leaked and contaminated the location. Generator repair activities may have also contaminated the location.
Decision to be Made • Determine if leaks or spills from activities occurring at PRL S-11 have contaminated the subsurface. • Determine if soils in the drainage ditch have been contaminated by runoff from PRL S-11. • Determine the location priority.
Inputs to the Decision Level II/III for VOCs in the soil gas; Level II/III for PCBs in the surface soil; Level III for inorganics, TPH, SVOCs, and dioxins/furans in the soil.
Boundaries of the Study Soil gas samples will be collected from approximately 20 to 40 feet BGS. Soil samples from surface to 5 feet.
Decision Rule • If organic compounds are reported in soil and/or soil gas, then the subsurface has been contaminated by spills or leaks of materials stored at the location. • If inorganic contaminants are reported above background concentrations in soil samples, then spills or leaks at PRL S-11 may have contaminated the location and the decision process for inorganics should be applied. • If suites of contaminants reported in the soil at PRL S-11 are also reported in the nearby drainage ditch, then contaminants from the location may have run off into the drainage ditch. • If VOCs are reported in the soil gas and if concentrations are greater than adjacent or surrounding borings, the contamination may have originated at this location. • If all data collected are validated, proceed to Data Evaluation DQOs (see Section 4.2.2).
Limits on Uncertainty Analytical data must meet project specifications for precision and accuracy.
Sample Design Borings SB1 through SB6 and hand augers HA1 through HA6 will be placed in areas of stained soil identified in historical photographs and around the perimeter of Building 636. Hand augers HA7 through HA9 will be placed in the drainage ditch. At least three additional hand augers, HA12 through HA14, may be placed in areas of highest PCB contamination indicated by immunoassay results if warranted.

(Continued)

TABLE 5.2-2. (Continued)

DATA QUALITY OBJECTIVES FOR TANK 6008

Problem Statement Diesel fuel may have leaked into the subsurface from the UST or associated piping.
Decision to be Made • Determine if leaks from the UST/piping have contaminated the subsurface. • Determine the location priority.
Inputs to the Decision Level II/III for soil gas; Level III for TPH.
Boundaries of the Study Soil and soil gas samples from approximately 20 to 40 feet BGS collected adjacent to the former tank location.
Decision Rule • If petroleum hydrocarbons are reported in the soil adjacent to and/or beneath the tank, leaks from the tank have contaminated the subsurface. • If all data are validated, proceed to Data Evaluation DQOs (see Section 4.2.2).
Limits on Uncertainty Analytical data must meet project specifications for precision and accuracy.
Sample Design Boring SB8 will be placed adjacent to the end of the former tank location.

(Continued)

TABLE 5.2-2. (Continued)

DATA QUALITY OBJECTIVES FOR BUILDING 635

Problem Statement

Solvents used to clean aircraft engines may have contaminated the subsurface. Aviation gas may have spilled and/or leaked from aboveground storage tanks.

Decision to be Made

- Determine if solvents used for cleaning aircraft engines have contaminated the subsurface.
- Determine if spills and/or leaks from the storage tanks contaminated surface soils.
- Determine the location priority.

Inputs to the Decision

Level II/III data for soil gas; Level III for TPH and BTEX in soil.

Boundaries of the Study

Soil gas samples will be collected from approximately 20 to 40 feet BGS. Soil samples from surface to 5 feet.

Decision Rule

- If organic compounds are reported in soil gas samples, then the subsurface has been contaminated by engine cleaning operations.
- If organic compounds are reported in soil samples, then the soil has been contaminated by spills or leaks of aviation gas.
- If all data collected are validated, proceed to Data Evaluation DQOs (see Section 4.2.2).

Limits on Uncertainty

Analytical data must meet project specifications for precision and accuracy.

Sample Design

Boring SB7 will be placed east of Building 635 where aircraft were maintained and cleaned using a solvent wash. Hand augers HA10 and HA11 will be placed adjacent to aviation gas dispensing system nozzles on the aboveground tanks.

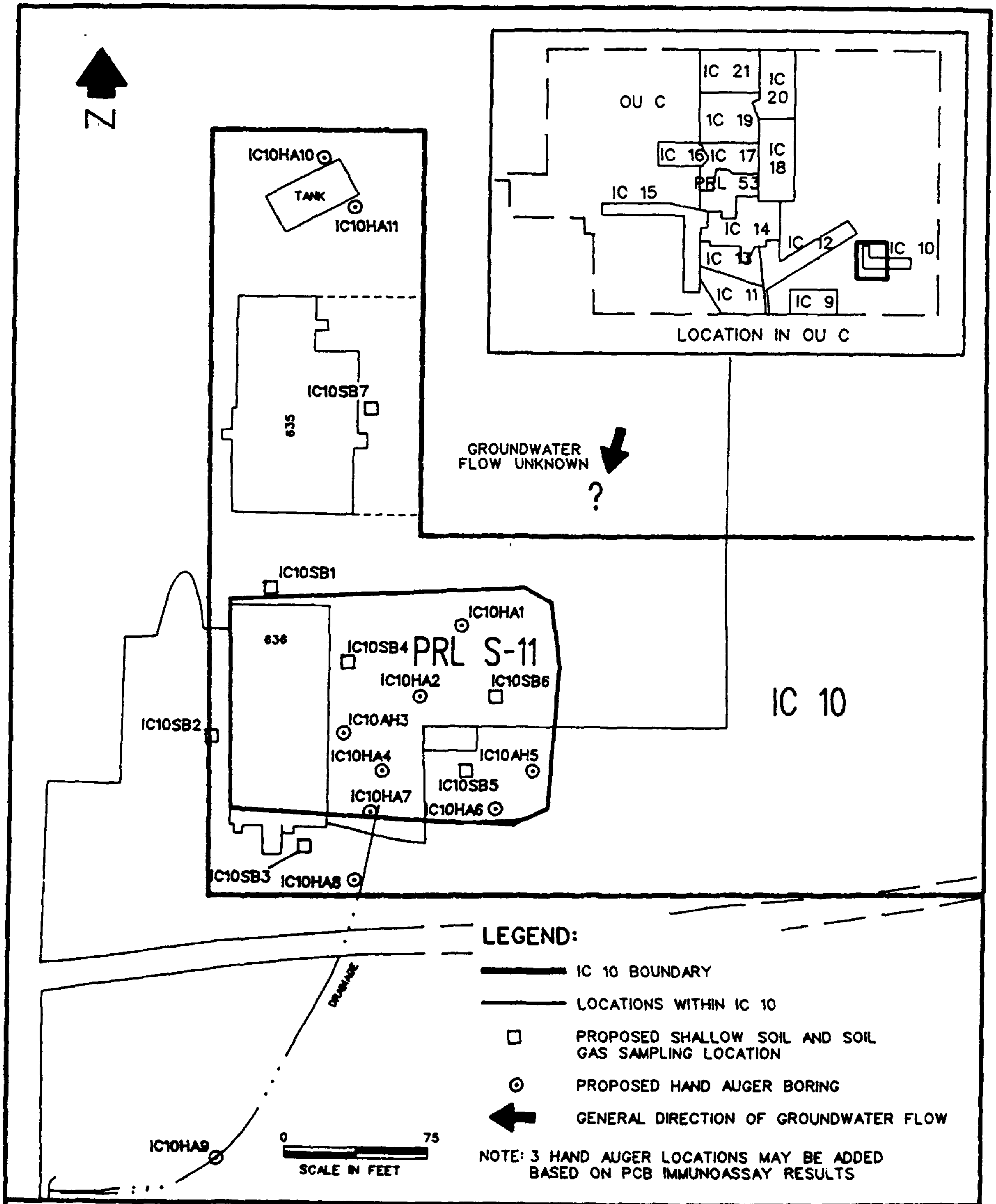


Figure 5.2-2 Proposed Sampling Locations at IC 10

OUC4 IC10PSL SAC 2/03/94

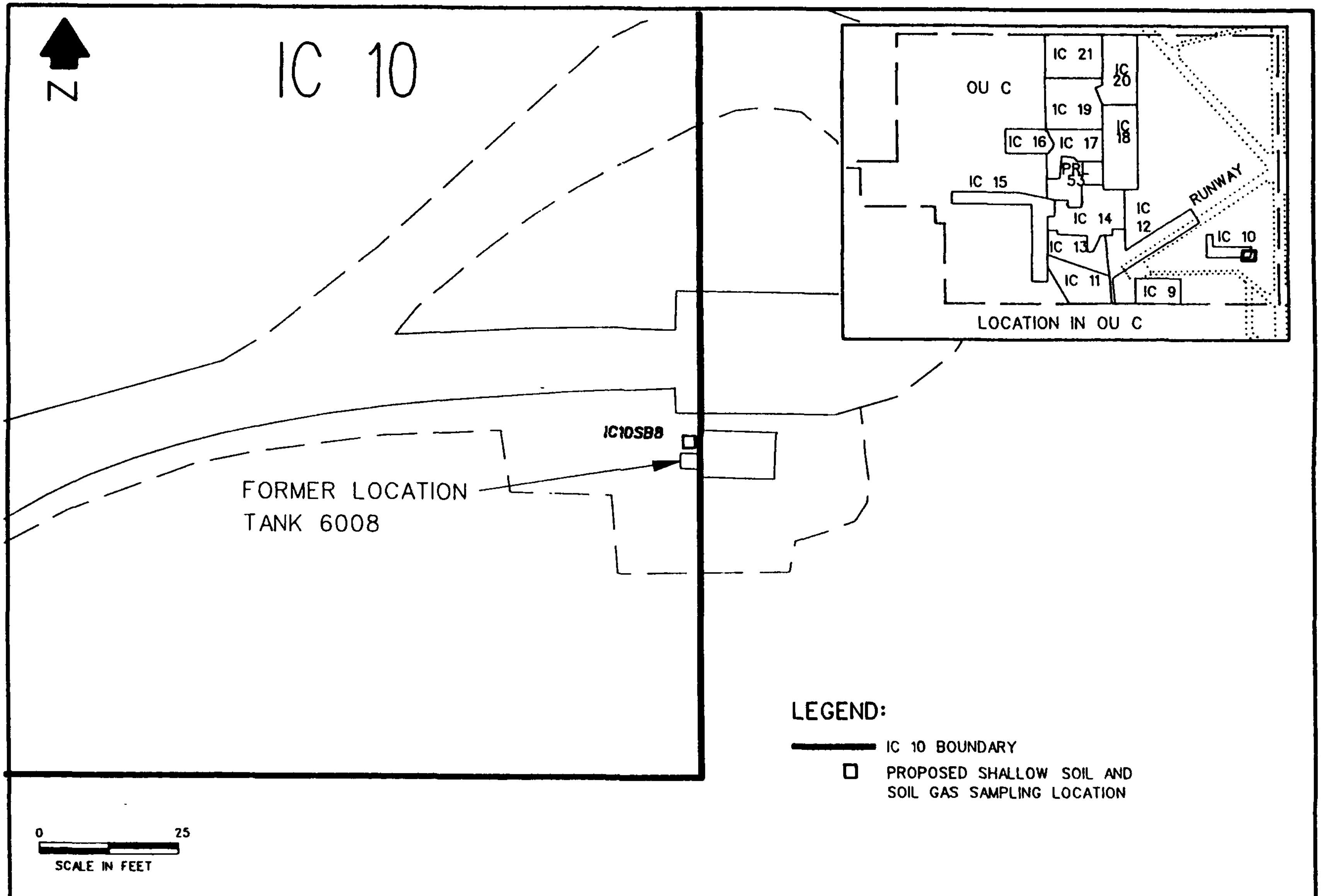


Figure 5.2-3 Proposed Sampling Locations in IC 10 at Tank 6008

OUC4 IC106008 SAC 2/26/94

TABLE 5.2-3. SAMPLING AND ANALYSIS MATRIX FOR IC 10

Location:	PRL S-11			Drainage Ditch	Tank 6008	Building 635	
Contaminant of Concern:	VOCs, SVOCs, TPH, PCBs, Inorganic species			VOCs, TPH, PCBs, Inorganic species	VOCs, TPH (diesel)	VOCs, TPH, BTEX (Aviation Fuel)	
Sampling Location:	Borings SB1-SB6	Hand Augers HA1-HA6	Hand Augers HA12[a]-HA14[a]	Hand Augers HA7-HA9	Borings SB8	Boring SB7	Hand Augers HA10-HA11
Depth and Analytical Methods:	(0-0.25') SW6010, IPCB, ModSW8015/3550	(0-0.25') IPCB, SW6010, ModSW8015/3550	(0-0.25') SW8080, SW8280	(0-0.25') SW8080[b], ModSW8015/3550, SW6010[b]	(10') ModSW8015/3550	(15-25') FGC	(0-0.25') ModSW8015/3550
	(1') SW8270	(1') SW8270	(3') SW8080, SW8280	(1') SW8270	(15-25') FGC	(35'-45') FGC	
	(5') ModSW8015/3550, ModSW8015/5030, SW8270, SW6010	(5') SW6010, ModSW8015/3550, ModSW8015/5030, SW8270		(5') SW6010, ModSW8015/3550, ModSW8015/5030, SW8270	(20') ModSW8015/3550		(5') ModSW8015/3550
	(15-25') FGC				(35-45') FGC		
	(35-45') FGC						

[a] Optional hand augers HA12-HA14 drilled at locations determined based on surface scrape results, if warranted.
[b] 5:1 composite sample.

IPCB = Immunoassay test for polychlorinated biphenyls.

NOTE: Matrix represents the minimum number of samples to be collected in each horizon.
FGC analyses will be confirmed with 10% TO-14 analysis.
Specific sample depths will be determined in the field using the sampling criteria specified in Section 4.
All acronyms are defined on the acronym list at the beginning of the SAP.

5.3 Field Sampling Plan for Investigation Cluster (IC) 11 (Potential Release Locations [PRL] 32, 56, 57, Magpie Creek and Tank 737)

Investigation Cluster 11 comprises PRLs 32, 56, and 57, a section of Magpie Creek, and underground storage tank (UST) 737 (Figure 5.3-1). The IC is located in the southern portion of Operable Unit (OU) C.

Potential Release Location 32 is a former storage area that was used to store containers holding hazardous and/or low-level radioactive wastes prior to off-base disposal. The storage area was used between 1956 and 1975 (CH2M HILL, 1993). The low-level radioactive waste stored at PRL 32 was generated during the decontamination of aircraft involved in nuclear testing. Wastes consisted of rags contaminated with hydraulic oils and Stoddard solvents. Washwater used in decontaminating aircraft was placed in a 500-gallon bowser and stored at PRL 32 while samples were analyzed for radioactivity. The washwater was then discharged at a rate based on the level of radioactivity detected in the water. The point of discharge for this water is unknown. There is a shallow surface drainage depression located adjacent to the northeast corner of PRL 32. Surface runoff from PRL 32 may have collected in the depression.

In the 1970s, a station wagon contaminated with an unknown quantity of mercury was stored at PRL 32 for about 2 years. The vehicle had become contaminated during a traffic accident that occurred while it was transporting mercury. The vehicle was later towed to one of the landfills (CS 10, CS 11, CS 12, CS 13, or CS 14) where it was crushed and burned (CH2M HILL, 1993).

Potential Release Location 56 is a surface storage area that was used periodically through the 1950s, 1960s, and 1970s for a variety of materials including pallets, airplane parts, and possibly 55-gallon drums (McLaren, 1986b).

Potential Release Location 57 was a surface depression west of PRL 56 where surface water runoff may have collected. Aerial photographs from the 1950s and 1960s show the depression trending west from the western portion of PRL 56 through PRL 57. The depression did not appear to discharge to Magpie Creek.

Magpie Creek is Gunite®-lined along the southern and western boundary of IC 11. The creek receives surface water runoff from OUs A, B, and C. During the 1940s, all industrial waste from the east side of McClellan AFB was discharged into Magpie Creek.

Tank 737 was a 500-gallon diesel tank located near Building 737. The tank was installed in 1984 and removed in 1993. A leak test was performed on the tank in October of 1986. Test results indicated that the system was leaking from a small gap in the manway gasket. The manway gasket was repaired, and the tank was retested in October 1988. Retesting indicated that the tank was no longer leaking. The quantity of diesel fuel that may have been discharged before leak testing is unknown.

Previous investigations of IC 11 are summarized in Table 5.3-1.

5.3.1 Data Quality Objectives

The data quality objectives for this stage of the remedial investigation (RI) at IC 11 are shown on Table 5.3-2.

5.3.2 Sampling Plan

Proposed sampling locations are shown in Figure 5.3-2. Potential contaminants of concern and the sampling and analytical matrix for IC 11 are shown in Table 5.3-3; field specifications for sampling locations are included in Table 5.3-4.

Rationale and specific objectives for sampling locations are outlined below.

To identify areas of radionuclide contamination, if any, field measurements will be taken at PRL 32 and its adjacent surface depressions and drainage ditch using a Geiger-Mueller counter and a 2-foot by 2-foot sodium iodide probe. The location will be screened with the Geiger-Mueller counter by traversing the location in a north-south and east-west direction with 3-foot spacing between traverses. If areas of increased radioactivity are reported, surface spill or leak boundaries can be identified using a pancake probe. Radionuclide contamination will be documented on a chart recorder. At least one hand auger will be drilled in each area of increased radioactivity; samples will be analyzed to speciate alpha, gamma, and beta radiation identified by the Geiger-Mueller counter. The hand auger sample results will indicate if radionuclide contamination has migrated vertically in the soil.

Two hand augers, HA1 and HA2, will be drilled about 80 feet apart in PRL 32 to determine whether contaminants, including radionuclides, TPH, and inorganic species, and mercury (from the mercury-contaminated vehicle) have contaminated the subsurface. One boring (SB1) will be drilled in the middle of PRL 32 to determine whether the soil and soil gas beneath PRL 32 are contaminated.

Five borings (SB2 through SB6) at PRL 56 will be drilled about 100 feet apart to determine if contaminants from potential spills and/or leaks have contaminated the surface and subsurface, and whether volatile contaminants are present in the soil gas.

Nine surface scrape samples (SS1 through SS9) will be collected in PRL 56 and analyzed for inorganic constituents and SVOCs to identify where spills and/or leaks of contaminants may have occurred.

Two hand augers (HA3 and HA4) will be drilled at PRL 57 to identify areas where surface spills and/or leaks may have occurred, and determine if contaminants entered the surface depression at PRL 57. No near-surface samples (< 1 foot BGS) will be collected at PRL 57 because the surface drainage ditch was backfilled with fill material. The bottom of the former drainage channel will be targeted.

One boring (SB7) will be drilled and sampled at Tank 737 adjacent to the former leak location. The former location of the tank and piping will be determined through a search of Civil Engineering construction diagrams. Soil and soil gas samples will be collected.

Sediment samples will be collected from three locations in Magpie Creek (MC1 through MC3) to determine if discharges into the creek have contaminated sediments. Sampling locations will be placed at creek outfalls, drainage confluences and bends in the creek. Samples at each location will be 5:1

composites of creek sediments. Sample MC1 will provide data on the presence of radionuclides from PRL 32 in creek sediments. Sample MC3 will provide upstream (baseline) data on radionuclides in creek sediments.

Bulk density samples will be collected from two different soil types in boring SB2 to provide information for vadose zone modeling and for evaluation of remedial alternatives.

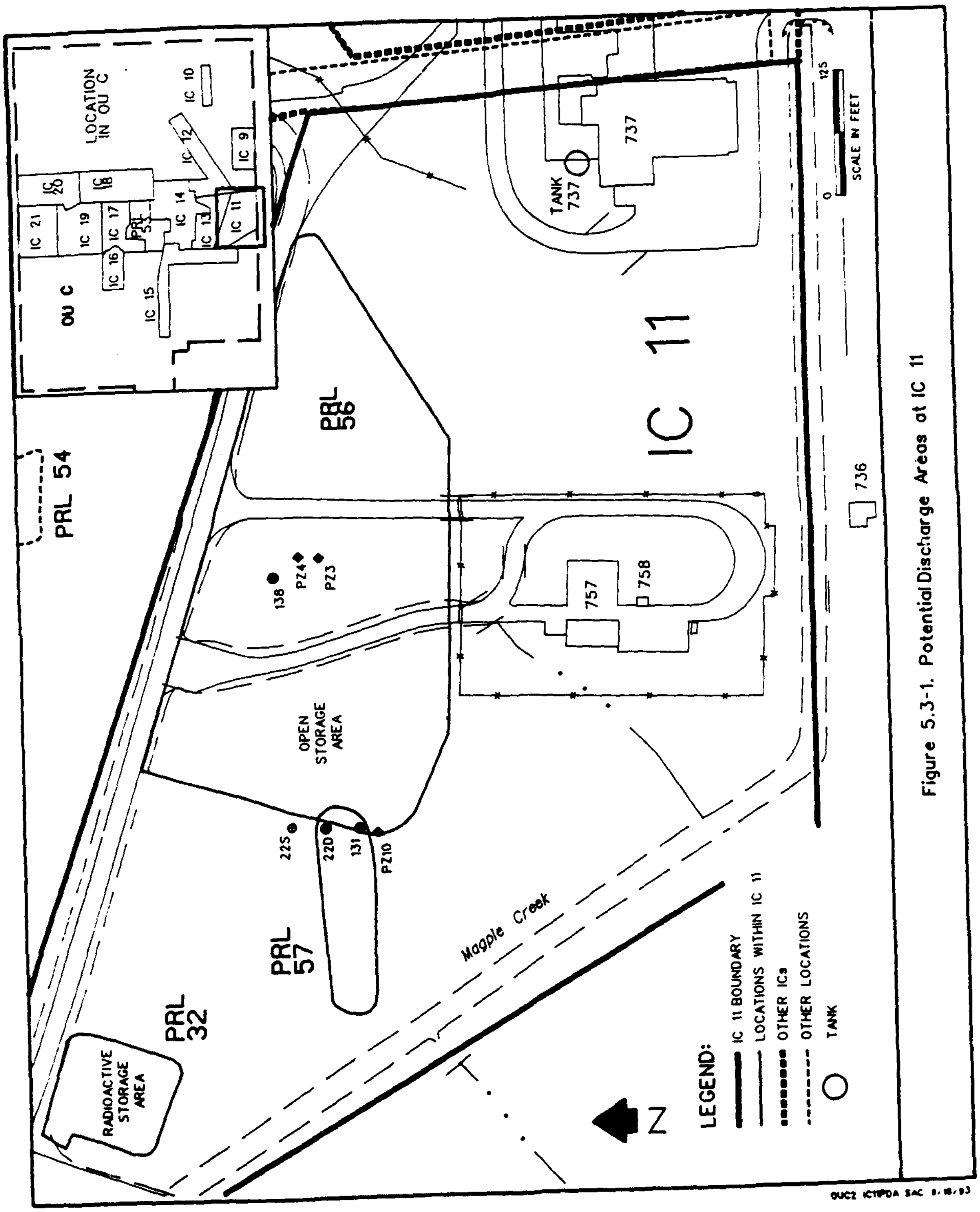


Figure 5.3-1. Potential Discharge Areas at IC 11

TABLE 5.3-1. PREVIOUS INVESTIGATIONS AT IC 11

Year, Contractor	Scope of Investigation	Key Findings
1985, McLaren Environmental Engineering	Investigation of potential contamination at PRLs 32, 56, and 57. A total of 55 soil borings were drilled. Twelve soil samples were submitted for analysis.	Soil samples were analyzed for VOCs, SVOCs, acid, bases, PCB, TPH, and inorganics. Samples from PRL 32 contain concentrations of SVOCs and TPH. Nothing was detected at PRLs 56 and 57.
1988, Radian Corporation	Basewide investigation of stream water and sediments for potential organic and inorganic contamination. One water sediment sample collected from Magpie Creek within IC 11.	Water samples contained lead, acetone, 4-nitrophenol and phenol. Sediment samples contained silver, lead, zinc, fluoranthene, phenol, and pyrene.
1993, CH2M HILL	Preliminary assessment of sites and locations in OU C.	Identified areas to be investigated in OU C through records review, site visits, and interviews with base personnel.
Ongoing, Radian Corporation	Groundwater sampling and analysis program to determine groundwater contaminant concentrations.	Concentrations of TCE, have been consistently reported in samples from MW-131 and EW-137. Extraction Well 137 is 1,100 feet southwest of PRL 56. Monitoring Well 131 is located within PRL 56 boundaries.

TABLE 5.3-2. DATA QUALITY OBJECTIVES FOR PRL 32

Problem Statement Low-level radioactive wastewater and mercury may have contaminated surface/subsurface soils during storage of these materials.
Decision to be Made • Determine if surface spills and/or leaks from containers stored at the site have contaminated surface and/or subsurface soils. • Determine the location priority.
Inputs to the Decision Level III data for radionuclides, inorganics, SVOCs, and TPH; Level II/III for VOCs in soil gas.
Boundaries of the Study Soil gas samples from approximately about 20 to about 40 feet BGS and soil samples collected from ground surface to 20 feet BGS within the former boundaries of the surface storage area.
Decision Rule • If organic compounds are reported in surface and subsurface samples, then the soil may have been contaminated from activities at the location. • If inorganic species or radionuclides are reported above background concentrations, the soil may be contaminated and the decision process for inorganic constituents should be applied. • If VOCs are reported in the soil gas and if concentrations are greater than nearby borings, the contamination is most likely originated at this location. • If all data collected are validated, proceed to Data Evaluation DQOs (see Section 4.2.2).
Limits on Uncertainty Analytical data must meet project specifications for precision and accuracy.
Sample Design The location will be screened by traversing the location with a Geiger-Mueller counter on a 3-foot spacing. If areas of elevated radioactivity are detected, a hand auger (HA5) will be placed in the area with highest concentrations. Boring SB1 will be placed in the middle of the location. Hand augers HA1 and HA2 will be placed 80 feet apart across the location.

(Continued)

TABLE 5.3-2. (Continued)

DATA QUALITY OBJECTIVES FOR PRLs 56 AND 57

Problem Statement Spill and/or leaks may have occurred during storage of 55-gallon drums at PRL 56. Surface drainage runoff from storage area may have contaminated drainage ditch.
Decision to be Made • Determine if spills and/or leaks from storage containers have contaminated surface and/or subsurface soils. • Determine if surface drainage runoff from the storage area has contaminated the former drainage ditch. • Determine the location priority.
Inputs to the Decisions Level III data for inorganics constituents and SVOCs; Level II/III for soil gas.
Boundaries of the Study Soil gas samples at about 20 feet BGS and soil samples from ground surface to 5 feet BGS.
Decision Rule • If organic compounds are reported in surface and near-surface samples, then the soil may have been contaminated from activities at the location. • If inorganic species are reported above background concentrations, the soil may be contaminated and the decision process for inorganic constituents should be applied. • If VOCs are reported in the soil gas and if concentrations are greater than adjacent or surrounding borings, the contamination most likely originated at this location. • If all data collected are validated, proceed to Data Evaluation DQOs (see Section 4.2.2).
Limits on Uncertainty Analytical data must meet project specifications for precision and accuracy.
Sample Design Borings SB2 through SB6 will be drilled approximately 100 feet apart in the areas, observed on aerial photographs, where most storage activity occurred. Surface scrapes SS1 through SS9 will be collected to fill in coverage across the location.

(Continued)

TABLE 5.3-2. (Continued)

DATA QUALITY OBJECTIVES FOR TANK 737

Problem Statement Diesel fuel may have leaked into the subsurface from Tank 737 or associated piping.
Decision to be Made • Determine if leaks from the UST/piping have contaminated the subsurface soils. • Determine if soil/soil gas contamination has migrated to groundwater. • Determine the location priority.
Inputs to the Decision Level III data for TPH in soil; Level II/III data for soil gas.
Boundaries of the Study Soil samples from 10 to 30 feet BGS, and soil gas samples from 20 to 40 feet BGS collected adjacent to the former leak location.
Decision Rule • If petroleum hydrocarbons are reported in the soil adjacent to and/or beneath the tank, leaks from the tank or associated piping have contaminated the soil. • If VOCs are reported in the soil gas, decrease with depth, and concentrations are higher than those reported along the IWL (IC 12), the contamination probably originated at this location. • If all data collected are validated, proceed to Data Evaluation DQOs (see Section 4.2.2).
Limits on Uncertainty Analytical data must meet project specifications for precision and accuracy.
Sample Design Boring SB7 will be placed adjacent to the point of discharge.

(Continued)

TABLE 5.3-2. (Continued)

DATA QUALITY OBJECTIVES FOR MAGPIE CREEK

Problem Statement Surface drainage runoff from industrial sites at McClellan AFB may have contaminated sediment deposits in Magpie Creek.
Decision Made • Determine if sediment deposits in Magpie Creek are contaminated. • Determine the location priority.
Inputs to the Decisions Level III data for SVOCs, inorganics, TPH, and radionuclides.
Boundaries of the Study Sediment samples collected at 0.25 feet within the creek.
Decision Rule • If organic compounds are reported in sediment samples, then sediments are contaminated. • If inorganic species above background concentrations are reported in sediment samples, then sediments may be contaminated and the decision process for inorganic species should be applied. • If all data are validated, then proceed to Data Evaluation DQOs (see Section 4.2.2).
Limits on Uncertainty Analytical data must meet project specifications for precision and accuracy.
Sample Design Composite surface scrapes MC1 through MC3 will be collected at outfall locations and at the closest point to PRL 32.

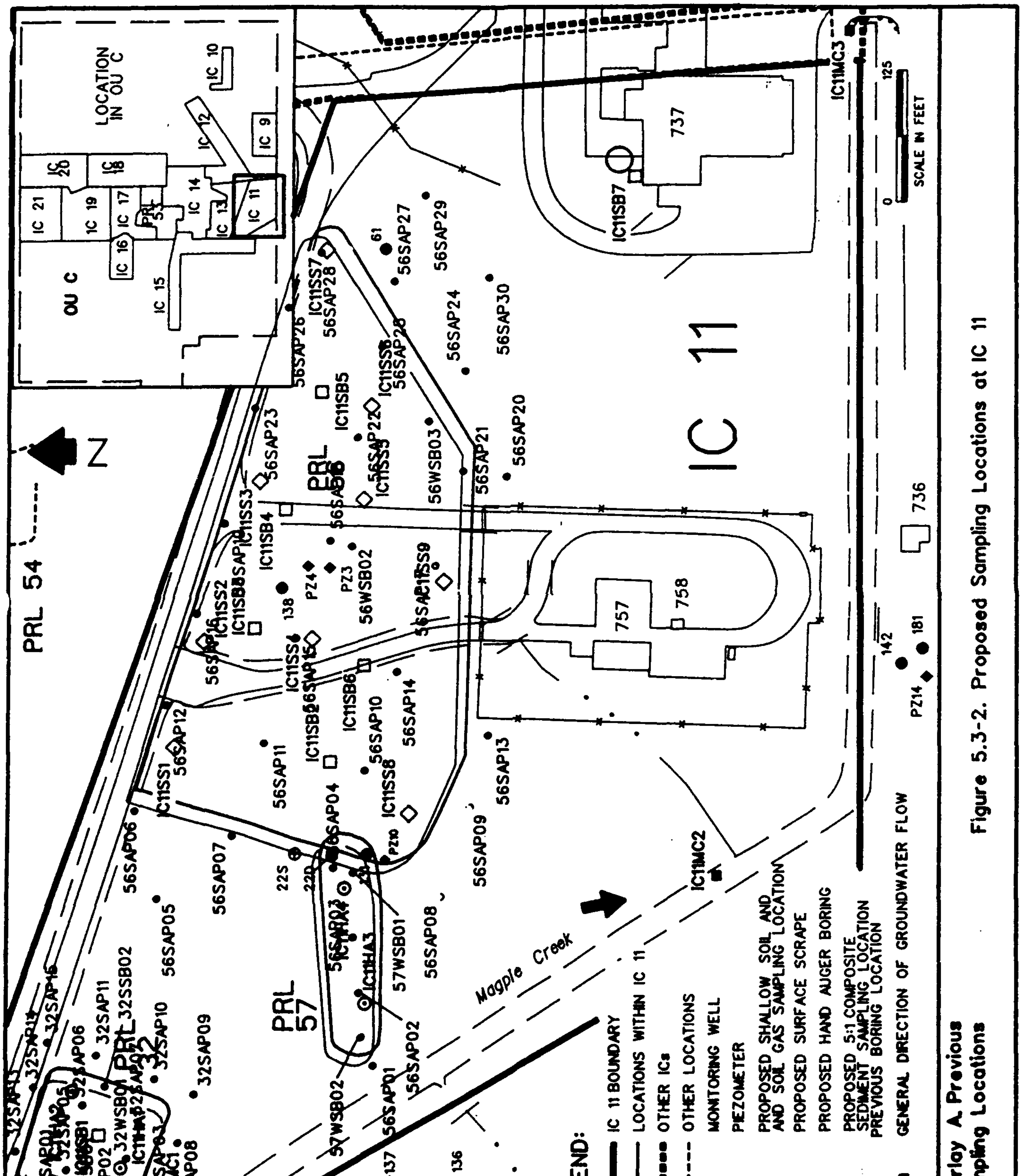


Figure 5.3-2. Proposed Sampling Locations at IC 11

TABLE 5.3-3. SAMPLING AND ANALYSIS MATRIX FOR IC 11

Location	PRL 32			PRL 56		PRL 57	Tank 737	Magpie Creek	
Contaminant of Concern:	VOCs, SVOCs, TPH, Inorganics, Radionuclides, Mercury			VOCs, SVOCs, Inorganics		SVOCs, Inorganics	VOCs, TPH	SVOCs, TPH, Inorganic species	
Sampling Location:	Boring SB1	Hand Augers HA1 and HA2	Hand Auger HA5[a]	Borings SB2[d]–SB6	Surface Scrapes SS1–SS9	Hand Augers HA3 and HA4	Boring SB7	Sediment Samples MC1[c] and MC3[c]	Sediment Samples MC2[c]
Depth and Analytical Method:	(0–0.25') SW6010, ModSW8015/ 3550, SW7471 (1') SW8270, E901.1 (5') ModSW8015/ 3550, ModSW8015/ 5030, SW8270 (10') E901.1 (15-25') FGC (20') E901.1 (35–45') FGC	(0–0.25') SW6010, ModSW8015/ 3550, SW7471 (1') SW8270 (5') ModSW8015/ 3550, ModSW8015/ 5030, SW8270, SW7471	(0–0.25') E901.1, SW9310 (5') E901.1 SW9310	(0–0.25') SW6010 (1') SW8270 (15–25') FGC	(0–0.25') SW6010 (1') SW8270	(3')[b] SW6010, SW8270 (5')[b] SW8270	(10') ModSW8015/ 3550 (15–25') FGC (20') ModSW8015/ 3550 (30') ModSW8015/ 3550 (35–45') FGC	(0-0.25') SW6010, ModSW8015/ 3550, SW8270, SW9310, E901.1	(0-0.25') SW6010, ModSW8015/ 3550, SW8270

[a] Hand auger location will be based on Geiger-Mueller results.
[b] Samples will be collected within and below the former drainage channel, if possible.
[c] 5:1 composite samples of the creek sediments.
[d] Two samples will be collected in different soil types for bulk density (ASTM 2937) analysis.

FGC = Screening analysis of soil gas for commonly detected VOCs with on-site chromatograph.

NOTE: Matrix represents the minimum number of samples to be collected in each horizon.
FGC analyses will be confirmed with 10% TO-14 analysis.
Specific sample depths will be determined in the field using the sampling criteria specified in Section 4.
All acronyms are defined on the acronym list at the beginning of the SAP.

TABLE 5.3-4. SAMPLING AND FIELD SPECIFICATIONS FOR IC 11

Boring/Location Name	Reference Point	Distance	Maximum Depth Interval (ft BGS)
Sediment Samples			
MC1	MW-22D	138'N, 345'W	0.25
MC2	MW-22D	353'S, 18'W	0.25
MC3	Northwest corner of Bldg. 737	188'S, 149'E	0.25
Surface Scrapes			
SS1	MW-22D	145'N, 102'E	1
SS2	MW-22D	119'N, 201'E	1
SS3	MW-61	114'N, 219'W	1
SS4	MW-22D	19'N, 197'E	1
SS5	MW-61	17'N, 237'W	1
SS6	MW-61	11'N, 149'W	1
SS7	MW-61	54'N, E/W=0	1
SS8	MW-22D	70'S, 41'E	1
SS9	MW-61	55'S, 315'W	1
Hand Augers			
HA1	MW-22D	194'N, 292'W	5
HA2	MW-22D	239'N, 220'W	5
HA3	MW-22D	30'S, 137'W	5
HA4	MW-22D	11'S, 30'W	5
HA5	To be determined	—	5
Borings			
SB1	MW-22D	215'N, 261'W	45
SB2	MW-22D	3'N, 87'E	25
SB3	MW-22D	72'N, 215'E	25
SB4	MW-61	90'N, 245'W	25
SB5	MW-61	58'N, 135'W	25
SB6	MW-22D	30'S, 177'E	25

5.4 Field Sampling Plan for Investigation Cluster (IC) 12 (Potential Release Locations [PRLs] S-48, 66A, and L-7A

Investigation Cluster 12 comprises PRLs S-48, 66A, and a section of the Industrial Wastewater Line (IWL) (PRL L-7A) (Figure 5.4-1). The IC is located in the southern portion of Operable Unit (OU) C.

Potential Release Location S-48 is the location of a jet engine test stand in the northernmost portion of IC 12. The test stand was located on a 50-foot by 50-foot concrete pad and operated from 1957 to 1973. Large amounts of jet fuel were spilled during the testing of jet engines (CH2M HILL, 1993). Analytical results from soil sampling along the western boundary of the site reported benzene, ethylbenzene, toluene, xylenes, naphthalene, gasoline, jet fuel, motor oil, and inorganic constituents.

Potential Release Location 66A includes the drainage area extending approximately 150 feet west of the test stands in Buildings 721, 732, 733, 734, and 735. These test stands were first visible in a 1957 aerial photograph. Prior to the installation of the IWL in 1974, PRL 66A received all the drainage from testing and maintenance operations in the test stands. Each test stand in Building 721 has a sump located just west of it to collect liquid wastes. The sumps reportedly drain to the IWL.

Potential Release Location L-7A is approximately 3,000 feet long and carries liquid waste from the test stands to the Industrial Wastewater Treatment Plant (IWTP). Wastewater is collected in trenches near the back of the test stands and flows by gravity to the IWL. Two sections of the IWL, behind Buildings 732 and 734, were not repaired after inspection in 1988 (EG&G, 1988). These two sections may have leaked contaminants to the subsurface. The section between MH-5 and MH-5B (see Figure 5.4-3) was rated as having a moderate potential for leakage during the 1993 IWL repair investigation.

Previous investigations conducted at IC 12 are summarized in Table 5.4-1.

5.4.1 Data Quality Objectives

The data quality objectives for this phase of the remedial investigation (RI) at IC 12 are shown in Table 5.4-2.

5.4.2 Sampling Plan

Proposed sampling locations are shown on Figures 5.4-2 and 5.4-3. Overlay A shows previous sampling locations. Potential contaminants of concern and the sampling and analytical matrix for IC 12 are shown in Table 5.4-3; field specifications for sampling locations are included in Table 5.4-4.

Rationale and specific objectives for sampling locations are outlined below.

A groundwater monitoring well will be installed at Boring SB7. A well in this area was recommended in the Draft Groundwater OU RI/FS Report to determine the direction of groundwater flow and water quality.

Boring SB7 will be located along the IWL. Soil gas samples will be collected from 20 feet BGS to the top of the water table. Water will be sampled with a HydroPunch®

when total depth is reached and sampled again after the well has been installed and developed.

Eight additional borings (SB1 through SB6, SB8, and SB9) will be drilled along the IWL to identify areas where leaks in the line may have contaminated the subsurface. Manholes, known leak locations (identified by EG&G Idaho in 1988), and a section of the line (between MH-5 and MH-5B) identified as having a moderate potential for leakage (by Jacobs Engineering in 1993) will be targeted for sample collection.

Five borings (SB10 through SB14) will be drilled and sampled within the boundaries of PRL 66A to characterize any subsurface contamination adjacent to the sumps and the IWL west of Building 721. Seven hand augers (HA1 through HA7) will be drilled about 75 feet from the back of the test stands to help determine if fuels or oils from the test stands contaminated the drainage areas.

Three surface scrapes (SS1 through SS3) will be sampled in PRL S-48 to confirm surface soil contamination identified in a 1988 investigation by McClellan AFB (see Table 5.4-1). Surface soil will also be sampled in borings SB15 and SB17. Results from surface soil samples will be used to determine the lateral extent of contamination. Subsurface soil and soil gas contamination in PRL S-48 will be defined to approximately 40 feet BGS in borings SB15 through SB17.

Physical parameter samples will be collected from different soil types in boring SB7 to provide information for vadose zone modeling and for evaluation of remedial alternatives.

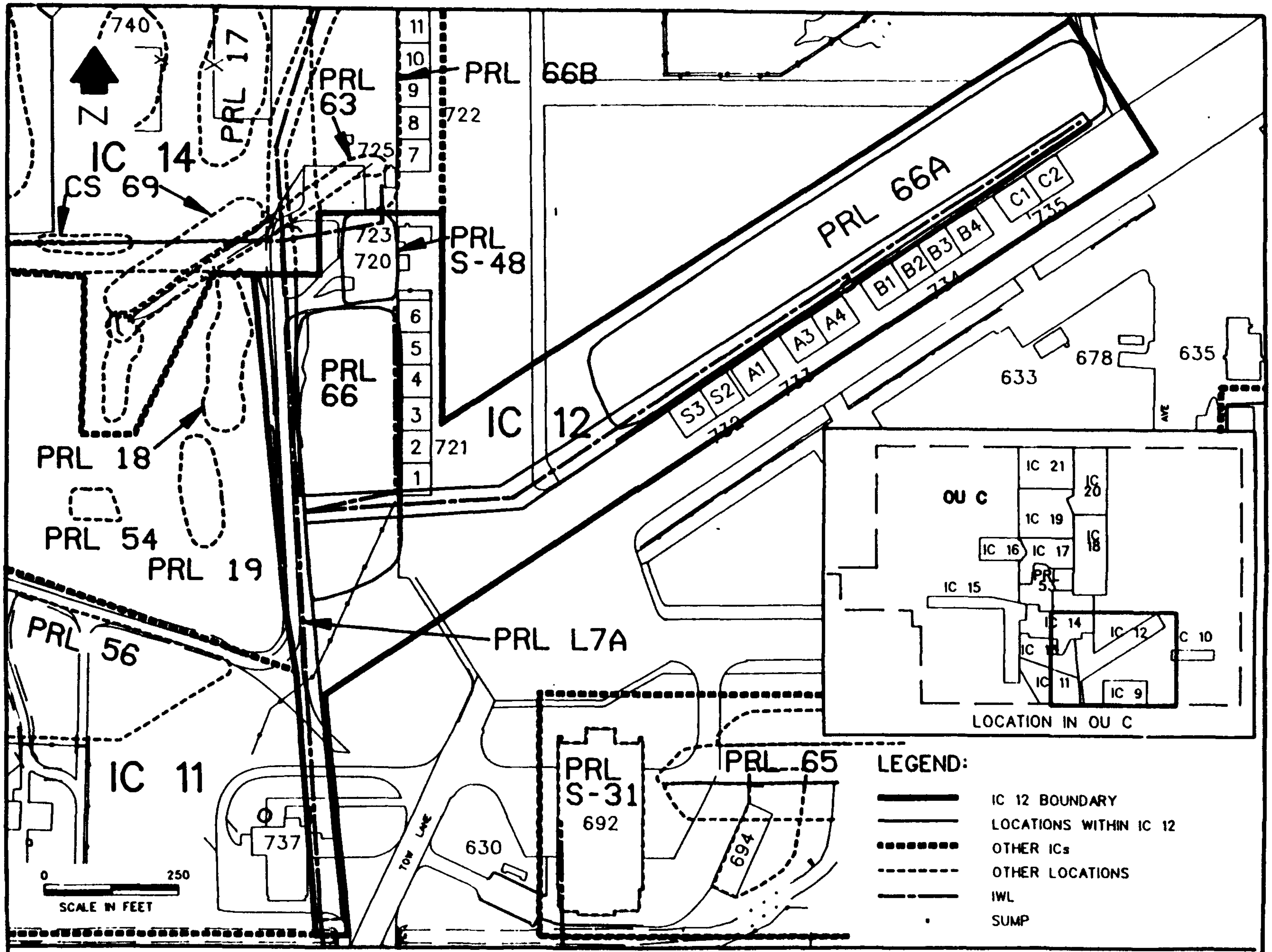


Figure 5.4-1 Potential Release Areas in IC 12

OUC2 IC12PDA SAC 9/17/93

TABLE 5.4-1. PREVIOUS INVESTIGATIONS AT IC 12

Year, Contractor	Scope of Investigation	Key Findings
1985, McLaren Environmental Engineers	Investigation of potential contamination at PRL 66. A total of five borings were drilled.	Samples taken at 4 feet BGS were analyzed for Priority Pollutants and samples taken at 69 feet were analyzed for VOCs. Although low HNu® readings were measured, soil sample analysis detected no priority pollutants.
1988, McClellan AFB	Investigation of potential contamination at PRL S-48 due to reports of free fuel hydrocarbons in the soil. Three borings were drilled.	Samples were collected down to 6 feet BGS. AVOCs, SVOCs, TPH, and inorganics were all reported in soil samples analyzed.
1988, EG&G Idaho	Investigation of the industrial wastewater collection system.	Some minor repairs were made to the IWL. Two off-set joints and possible break not repaired.
1993, CH2M HILL	Preliminary Assessment of sites and locations in OU C.	Identified areas to investigation through records review, site visits, and interviews with base personnel.
1993, Jacobs Engineering Group	Investigation of the IWL.	The section of IWL between MH-5 and MH-5B was rated as having a moderate potential for leakage.
Ongoing, Radian Corporation	Groundwater Sampling and Analysis Program to determine groundwater contaminant concentrations. MW 61 is downgradient of IC 12.	Concentrations of HVOCs and AVOCs have been consistently reported in samples from MW 61, 350 feet southwest of PRL 66A and 50 feet west of the IWL.

NOTE: Acronyms are defined in the acronym list at the beginning of the SAP.

TABLE 5.4-2. DATA QUALITY OBJECTIVES FOR PRL S-48

Problem Statement Jet fuel was reportedly spilled at this location. This and other contaminants have been detected in the surface and near surface soil.
Decision to be Made • Determine the source area of contamination. • Determine location priority.
Inputs to the Decision Level II/III data for VOCs in soil gas; Level III data for SVOCs, TPH, and inorganic species in soil.
Boundaries of the Study Soil gas samples will be collected from approximately 20 to 40 feet BGS. Soil samples will be collected from the surface to 40 feet BGS.
Decision Rule • If organic compounds are reported in surface soil samples, then the surface is contaminated and the source area may be defined from concentration gradients. • If inorganic species are reported above background in soil samples at the location, the decision process for inorganic contamination should be applied. • If VOCs are reported in soil and/or soil gas and if concentrations decrease with depth, then the vertical extent has been defined in that area. • If VOCs are reported in soil gas, and if concentrations increase with depth, contaminants may be off gassing from the groundwater and contaminating the deep soil gas. • If VOCs are reported in the soil gas and if concentrations are greater than adjacent or surrounding borings, the contamination may have originated at this location. • If all data collected are validated, then apply Data Evaluation DQOs (see Section 4.2.2).
Limits on Uncertainty Analytical data must meet project specifications for precision and accuracy.
Sample Design Borings SB15 through SB17 will be drilled in areas of previously reported contamination in surface and near surface soils. Surface scrape samples will be collected at the boring locations and at surface scrapes SS1 through SS3 to determine the lateral extent of surface contamination.

(Continued)

TABLE 5.4-2. (Continued)

DATA QUALITY OBJECTIVES FOR PRL 66A

Problem Statement Contaminants may have been spilled or washed onto the surface, and/or drained into the subsurface at PRL 66A.
Decision to be Made • Determine if the surface and/or subsurface has been contaminated by drainage from the nearby test stands. • Determine if the sumps collecting liquid waste from Building 721 have contaminated the subsurface. • Determine the location priority.
Inputs to the Decision Level II/III data for VOCs in soil gas; Level III data for SVOCs, TPH, and inorganic species in soil.
Boundaries of the Study Soil gas samples will be collected from about 20 to 40 feet BGS at the sumps on the west side of Building 721. Soil samples will be collected from the surface to 10 feet.
Decision Rule • If organic compounds are reported in soil samples, then the surface and/or subsurface has been contaminated by drainage from test stands and/or leaks in the sumps. • If inorganic species are reported above background in soil samples at the location, then drainage from the test stands and/or leaks in the sumps may have contaminated the subsurface and the decision process for inorganic contamination should be applied. • If VOCs are reported in the soil gas and if concentrations are greater than adjacent or surrounding borings, the contamination may have originated at this location. • If all data collected are validated, then apply Data Evaluation DQOs (see Section 4.2.2).
Limits on Uncertainty Analytical data must meet project specifications for precision and accuracy.
Sample Design Borings SB10 through SB14 will be drilled next to the sumps at Building 721. Hand augers HA1 through HA4 will be drilled in surface depressions to determine if drainage from the test stands contaminated surface and near surface soils.

(Continued)

TABLE 5.4-2. (Continued)

DATA QUALITY OBJECTIVES FOR SOIL GAS AT PRL L-7A

Problem Statement Liquid waste may have leaked into the subsurface from the IWL (PRL L-7A).
Decision to be Made • Determine if leaks in the IWL (PRL L-7A) have contaminated the subsurface. • Determine the location priority.
Inputs to the Decision Level II/III data for VOCs in soil gas.
Boundaries of the Study Soil gas samples from about 20 to 100 feet BGS.
Decision Rule • If suites of VOCs reported in soil gas, and if concentrations decrease with distance horizontally and with depth, then soil gas contamination probably originates at the IWL. • If VOC concentrations are low or not detected in the shallow soil gas (<40 feet BGS), but are reported or increase with depth in the deep soil gas (>40 feet BGS), the soil gas contamination is probably from the smear zone left by declining water levels. • If all data collected are validated, then apply Data Evaluation DQOs (see Section 4.2.2).
Limits on Uncertainty Analytical data must meet project specifications for precision and accuracy.
Sample Design Borings SB1 through SB9 will be drilled at manholes and known crack locations, and at 100-foot intervals along sections rated as having high or moderate potential for leakage.

(Continued)

TABLE 5.4-2. (Continued)

DATA QUALITY OBJECTIVES FOR GROUNDWATER BENEATH IC 12

Problem Statement

The eastern edge of the A zone plume in OU C is not bounded.

Decision to be Made

- Determine groundwater flow directions.
- Determine if the groundwater beneath IC 12 is contaminated.
- Determine location priority.

Inputs to the Decision

Level III data for groundwater. Previous groundwater flow and contaminant data.

Boundaries of the Study

Groundwater samples from the A monitoring zone.

Decision Rule

- Contaminants from the location have contaminated the groundwater if all of the following are true:
  - Organic compounds above background are reported in groundwater samples downgradient of the location,
  - Those suites of compounds are also reported in soil gas beneath the location, and
  - Those compounds or species are not reported or are reported at lower concentrations in upgradient samples.
- If all data collected are validated, proceed to Data Evaluation DQOs (see Section 4.2.2).

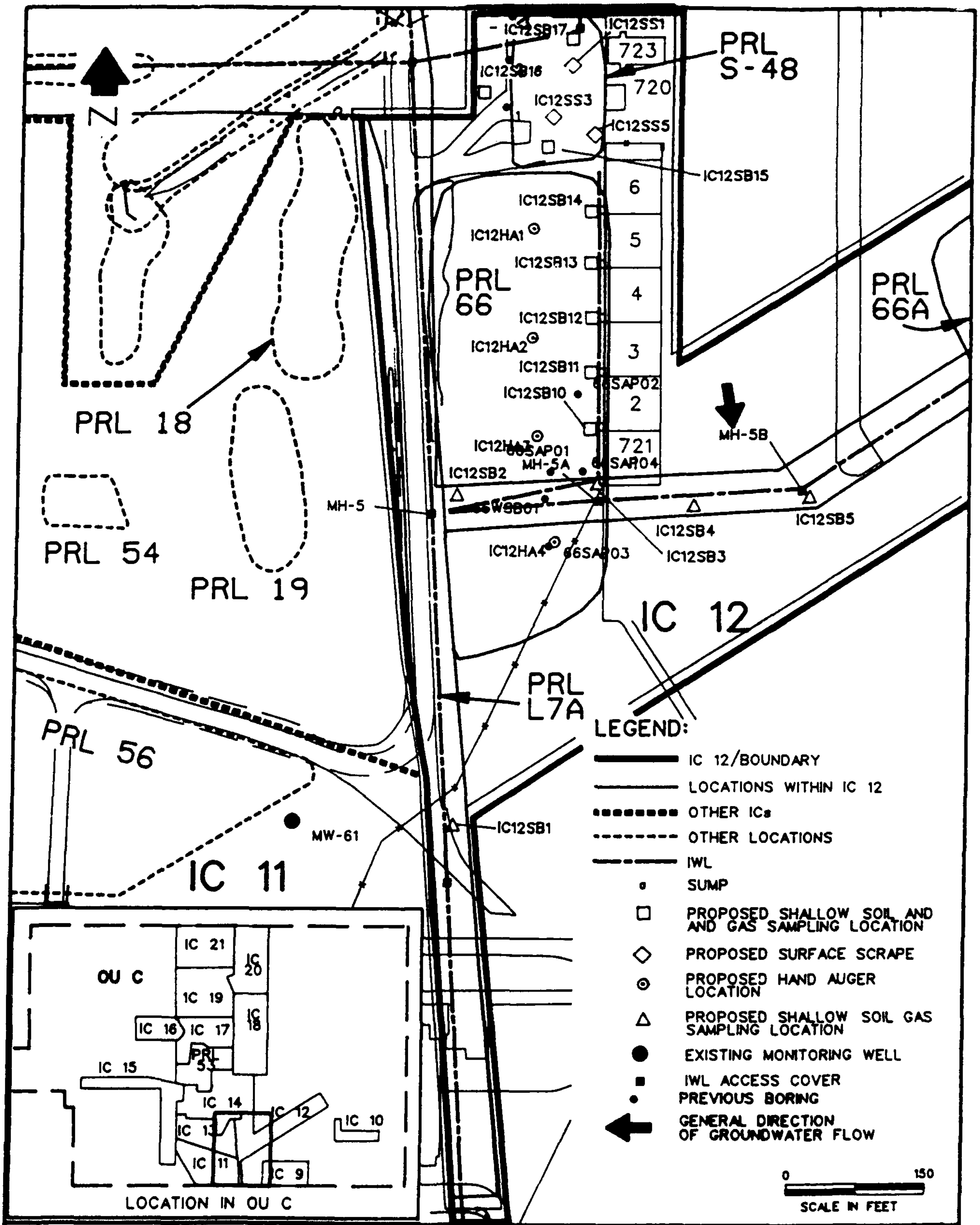
Limits on Uncertainty

Analytical data must meet project specifications for precision and accuracy.

Sample Design

Boring SB7 will be drilled to groundwater and a monitoring well installed to define flow directions and contaminant migration in support of the Groundwater OU.

NOTE: All acronyms are defined in the acronym list at the beginning of the SAP.



Overlay A. Previous Sampling Locations

Figure 5.4-2 Proposed Sampling Locations in IC 12 (Western Portion)

OUCS IC12PSLA SAC 04/19/94

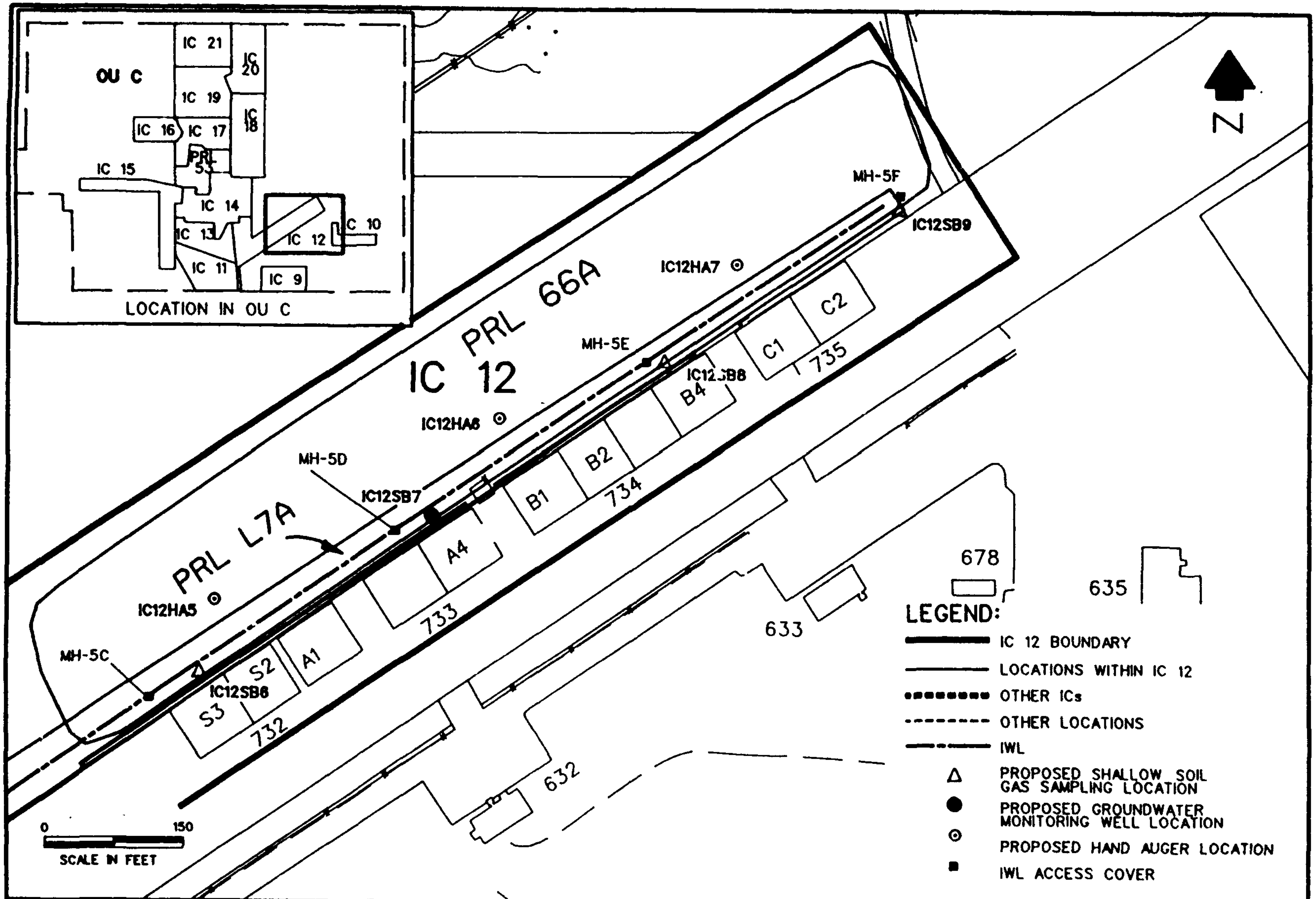


Figure 5.4-3 Proposed Sampling Locations in IC 12 (Eastern Portion)

OUC4 IC12PSLB SAC 2/25/94

TABLE 5.4-3. SAMPLING AND ANALYSIS MATRIX FOR IC 12

Location:	PRL S-48		PRL 66A		PRL L-7A	
Potential Contaminants of Concern:	Inorganic species, VOCs, SVOCs, TPH		Inorganic species, VOCs, SVOCs, TPH		VOCs	
Sampling Location:	Borings SB15-SB17	Surface Scrapes SS1-SS3	Borings SB10-SB14	Hand Augers HA1-HA7	Borings SB1[a]-SB6[a], SB8[a]-SB9[a]	Borings SB7[a,b]
Sample Depth and Analytical Method:	(0-0.25') SW6010, ModSW8015/3550	(0-0.25') SW6010, ModSW8015/3550	(0-0.25') SW6010, ModSW8015/ 3550	(0-0.25') SW6010, ModSW8015/3550	(15-25') FGC	(15-25') FGC
	(1') SW8270	(1') SW8270	(1') SW8270	(1') SW8270	(35-45') FGC	(35-45') FGC
	(5') SW6010, ModSW8015/3550, ModSW8015/5030, SW8270		(5') SW6010, ModSW8015/3550, ModSW8015/5030, SW8270	(5') ModSW8015/3550, ModSW8015/5030 SW8270		(55-65') FGC
	(15-25') FGC (20') ModSW8015/3550, ModSW8015/5030, SW8270, SW6010		(10') ModSW8015/3550, ModSW8015/5030, SW8270, SW6010			(75-85') FGC
			(15-25') FGC			(90-100') FGC
	(35-45') FGC		(35-45') FGC			(groundwater) SW8260[c]
	(40') ModSW8015/3550, ModSW8015/5030, SW8270, SW6010					

[a] Also serves for location PRL 66A.
[b] Four samples will be collected for bulk density analysis (ASTM 2937) in different soil types.
[c] The benefits and limitations of Method SW8260 are currently being compared with Methods SW8010 and SW8020. Depending on the outcome of this review, Methods SW8010 and SW8020 may be used instead of SW8260.

FGC = Screening analysis of soil gas for commonly detected VOCs with on-site chromatograph.

NOTE: Matrix represents the minimum number of samples to be collected in each horizon.
FGC analyses will be confirmed with 10% TO-14 analysis.
Specific sample depths will be determined in the field using the sampling criteria specified in Section 4.
All acronyms are defined on the acronym list at the beginning of the SAP.

TABLE 5.4-4. SAMPLING AND FIELD SPECIFICATIONS FOR IC 12

Boring/Location Name	Reference Point	Distance	Maximum Depth Interval (ft BGS)
Surface Scrape			
SS1	Northwest corner of Bldg. 721	103'N, 38'W	1
SS2	Northwest corner of Bldg. 721	27'N, 12'W	1
SS3	Northwest corner of Bldg. 721	46'N, 58'W	[illegible]
Borings			
SB1	MW-61 (in IC 11)	4'S, 174'E	45
SB2	Southwest corner of Bldg. 721	14'S, 162'W	45
SB3	Southeast corner of Bldg. 721	11'S, 66'W	45
SB4	Southeast corner of Bldg. 721	20'S, 39'W	45
SB5	Southeast corner of Bldg. 721	14'S, 160'E	45
SB6	Northwest corner of Bldg. 734	199'S, 326'W	45
SB7	Northwest corner of Bldg. 734	31'S, 77'W	100
SB8	Northwest corner of Bldg. 734	134'N, 175'E	45
SB9	Northwest corner of Bldg. 734	296'N, 425'E	45
SB10	Southeast corner of Bldg. 721	60'N, 76'W	45
SB11	Southeast corner of Bldg. 721	122'N, 76'W	45
SB12	Northwest corner of Bldg. 721	177'S, 13'W	45
SB13	Northwest corner of Bldg. 721	115'S, 13'W	45
SB14	Northwest corner of Bldg. 721	56'S, 13'W	45
SB15	Northwest corner of Bldg. 721	8'N, 53'W	45
SB16	Southwest corner of Bldg. 723	34'S, 135'W	45
SB17	Southwest corner of Bldg. 723	26'N, 36'W	45
Hand Augers			
HA1	Northwest corner of Bldg. 721	75'N, 77'W	5
HA2	Southwest corner of Bldg. 721	162'N, 79'W	5
HA3	Southwest corner of Bldg. 721	53'N, 70'W	5
HA4	Southwest corner of Bldg. 721	62'S, 51'W	5
HA5	Northeast corner of Bldg. 732	45'N, 60'W	5
HA6	Northwest corner of Bldg 734	70'N, 3'W	5
HA7	Northwest corner of Bldg. 735	41'N, 2'E	5

5.5 Field Sampling Plan for Investigation Cluster (IC) 13 (Potential Release Locations [PRLs] 18, 19, 54, 55, and a Former Gas Station)

Investigation Cluster 13 comprises PRLs 18, 19, 54, 55 and a former gas station (Figure 5.5-1). The IC is located in the southern section of Operable Unit (OU) C, east of Patrol Road. The western portion of IC 13 is in the Civil Engineering soil pile area, where clean soil is stored, and is adjacent to OU C1.

Potential Release Locations 18 and 19 are reportedly burial pits that may have been used for burned debris from the burning pit and teepee burner at Confirmed Site (CS) 22 in OU C1, and possibly for other solid and hazardous waste (CH2M HILL, 1993). They may have been used from 1957 to 1959.

Potential Release Location 54 is a bermed area that is visible in aerial photographs taken in the mid-1960s. It appears to be earthen-bermed. The location is approximately 40 feet by 100 feet in size and is east of the soil pile area. It is not known what materials might have been stored or used there.

Potential Release Location 55 includes the concrete building foundation of an acid storage area (where automobile batteries were stored before disposal), a possible burial pit, and another small pit that may have been used for liquid or sludge disposal during the 1950s. In the late 1960s, PRL 55 and the area north to the Industrial Wastewater Treatment Plant (IWTP) (IC 14) were used for open (i.e., uncovered) storage of miscellaneous equipment. Surface runoff from PRL 55 would flow to the unlined ditch immediately north of the PRL, into a storm drain and thence into Magpie Creek.

A gas station that operated in the 1940s is also located in IC 13 (McClellan Air Force Base [AFB], 1945). The station was located along Patrol Road east-southeast of the incinerator at CS 22. The tanks from this gas station may have been filled with sand and left in place (CH2M HILL, 1993); no other information is available about the gas station.

The western portion of IC 13 lies directly south of OU C1, where a Remedial Investigation (RI) is currently underway. Operable Unit C1 is apparently the source of a groundwater contaminant plume that also underlies IC 13. Because the water table beneath IC 13 has declined 40 to 50 feet since the 1950s, and flow directions have changed, it is very likely that a large "smear zone" will be encountered in the deep vadose zone: e.g., residual contamination left in the soil and soil gas as the water table declined. Preliminary data from OU C1 indicate total halogenated volatile organic compounds (VOCs) greater than 100,000 ppbv in the soil gas at depths greater than 40 feet below ground surface (BGS).

Before Magpie Creek was channelized and its course altered (between 1943 and 1945), Magpie Creek flowed through what is now IC 13 (Figure 5.5-1). The old channel has since been filled in. In the 1940s, industrial wastewater from the eastern portion of McClellan AFB (OU A) was disposed to Magpie Creek; according to CH2M HILL (1993, page 1.10-14), as much as 500 gallons of oil per day were removed from Magpie Creek at the skimming basin (PRL 28, downstream of IC 13) in 1943 and 1944. Some of the contaminants in the creek could have remained in the creekbed or penetrated the subsurface beneath.

Monitoring Well (MW) 61 (an A-zone well) is located south of the eastern portion of IC 13. The contaminants consistently detected in groundwater samples from this well include trichloroethene (TCE) and cis-1,2-dichloroethene (cis-1,2-DCE). While this combination of contaminants is not different from those found in and south of OU C1, historical groundwater flow directions would tend to suggest a source other than OU C1 for the contamination in MW-61's water.

Although not sources of contamination, two possible conduits for contaminant migration are located within IC 13: Base Well (BW) 16 and Deep Exploration Boring (DEB) C1. Base Well 16, an inactive water supply well, is usually listed as being located in OU A (Ludorff and Scalmanini, 1984); however, according to a McClellan AFB Civil Engineering drawing (1945), this well is actually about 75 feet east of the former gas station. The top of the well screen is reportedly 78 feet below ground surface (BGS) (Ludorff and Scalmanini, 1984); how long the screen is or whether the well was ever properly abandoned are unknown. Deep Exploration Boring C1 was drilled by McLaren Environmental Engineers in 1985 to a depth of about 300 feet BGS. It is located about 30 feet south of MW-33S. The boring was difficult to abandon due to grout loss into the formation (McLaren Environmental Engineers, 1986a). The boring may not have been properly abandoned beneath the water table and may provide a conduit for groundwater contamination to migrate deeper. Both BW-16 and DEB C1 will be investigated by the McClellan AFB Well Abandonment Team to determine what future action, if any, should be taken. Base Well-16 is scheduled in the current well abandonment effort, whereas DEB C1 will be investigated in a subsequent phase.

Previous investigations of IC 13 are summarized in Table 5.5-1.

5.5.1 Data Quality Objectives

The data quality objectives for this stage of the IC 13 RI are shown on Table 5.5-2.

5.5.2 Sampling Plan

Proposed sampling locations are shown on Figures 5.5-2 and 5.5-3. Overlays A and B show previous sampling locations. Potential contaminants of concern and the sampling and analytical matrix for IC 13 is shown in Table 5.5-3; field specifications for sampling locations are included in Table 5.5-4.

The western portion of IC 13 is the soil pile area. The piles of dirt may need to be removed or the proposed borings relocated before drilling can begin. Because the area has been used to store soils and, therefore, the surface has been repeatedly disturbed, no surface scrape samples will be collected from this area.

A geophysical survey will first be conducted to locate BW-16 and DEB-C1. A determination can then be made of the need for further action. Geophysics will also be used to determine the locations of the tanks at the former gas station, and whether the tanks are still in place.

Groundwater samples will be collected from MW-128, MW-129, MW-130 and analyzed for semivolatile organic compounds (SVOCs) and cyanide in coordination with the Groundwater OU (sampling and analysis program). 1,2-Dichlorobenzene was reported in samples from MW-33S and MW-128 in the

mid-1980s. Cyanide was reported in two water samples from DEB-C1. Monitoring Well 33S is now dry, and samples are not normally collected from MWs 128, 129, and 130 for cyanide or SVOC analysis.

Rationale and specific objectives for sampling locations are outlined below.

Borings SB1 and SB2 will be drilled adjacent to the building foundation at PRL 55. Boring SB1 will be sampled to determine whether nonvolatile and volatile contaminants and acids (adjacent to the acid storage area) have contaminated the subsurface at PRL 55. Boring SB2 will be sampled to determine whether VOCs have migrated into the soil gas, and if SVOCs, inorganic species, acids, and petroleum hydrocarbons have migrated into the soil.

Surface scrapes MC1 and MC2, placed next to the storm drains in the ditch near PRL 55, are intended to determine whether any contaminants from PRL 55 are in the ditch sediments. Both samples will be 5:1 composite samples.

Borings SB3 and SB4 will be placed around the tanks at the former gas station location. Exact boring locations may change pending geophysical results. Samples from these borings will help determine whether the tanks leaked and contaminated the subsurface. Bulk density (ASTM 2937) samples will be collected in boring SB3 to determine water-filled porosity, which will indicate whether the oxidation ponds (PRL 60) (see Section 5.7) are providing a hydraulic driving force for vertical contaminant migration.

Boring SB5 is intended to determine whether materials historically stored in PRL 54 (the bermed area) have contaminated the subsurface. Nothing is known about the types of materials that were kept in PRL 54 or the depth to the original surface of the bermed area. To help locate the original surface of the bermed area, and determine if contaminants were spilled there, Boring SB5 will be drilled with a hollow-stem auger.

Borings SB6, SB7, and SB8 will provide physical indications and samples of wastes or disturbed soil, to determine if PRLs 18 and 19 were used as burial pits. The analytical results will also help determine whether any contaminants disposed in the pits have migrated to the subsurface.

Two trenches will be dug to locate the former Magpie Creek channel. Samples will be collected at the former creekbed surface and 3 feet below the former surface (in HA1 and HA2) to determine if sediments are contaminated.

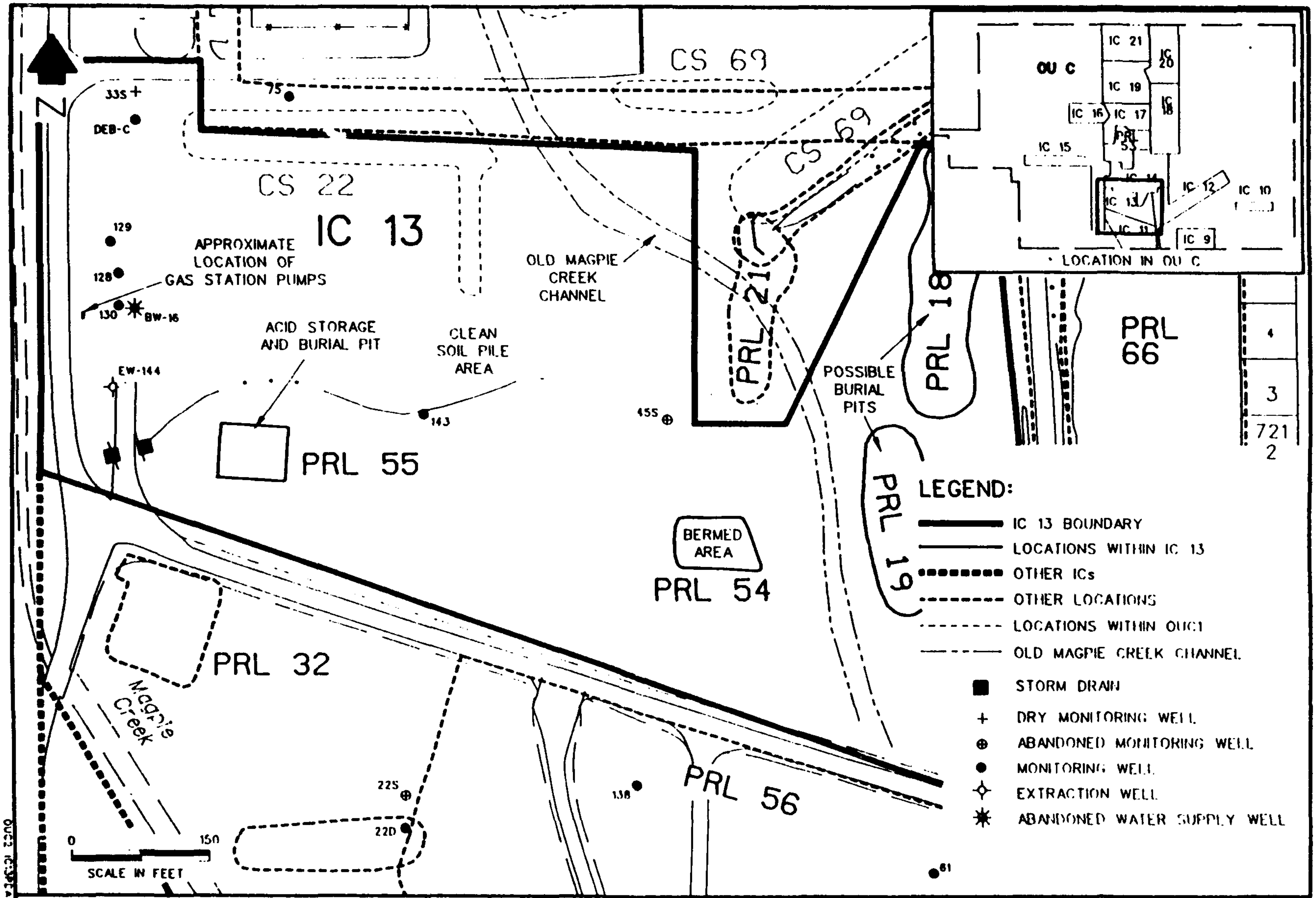


Figure 5.5-1 Potential Discharge Areas at IC 13

OUC2 IC13PEA SAC 9/13/93

TABLE 5.5-1. PREVIOUS INVESTIGATIONS AT IC 13

Year, Contractor	Scope of Investigation	Key Findings
1985, McLaren Environmental Engineers	Investigation of potential contamination. PRLs 18 and 19 were delineated by GPR. A total of 33 borings (both shallow and deep) were drilled at PRLs 18, 19, 54, and 55. Samples (collected only in some borings) were analyzed for VOCs. Samples from PRLs 54 and 55 were also analyzed for acid and base/neutral extractable compounds, pesticides, herbicides, PCBs, oil and grease, metals, and cyanide.	PRLs 18 and 19: Borings encountered only undisturbed soil profiles; no wastes were encountered. No samples were collected. PRL 54: No visible contamination or wastes encountered in 11 borings. Only contaminant detected was vanadium above subsurface background concentrations at 15 feet BGS. PRL 55: Discolored soil or solvent odors were noted in 4 borings. Cobalt was detected above subsurface background, and VOCs were detected in soil at 80 feet BGS.
1985, McLaren Environmental Engineers	Site characterization investigation of Area C. DEB-C1 was drilled about 30 feet south of MW-33S to 300 feet BGS to characterize vertical extent of groundwater contamination and determine lithology.	DEB-C1 was drilled, cased, sampled, and abandoned. Groundwater samples were collected from six depths: TCE was detected in four samples from 117 to 227 feet BGS; cyanide was reported in samples from 190 and 230 feet BGS; three SVOCs were detected in a sample from 210 feet BGS; and arsenic (1 sample), chromium, and lead were detected above drinking water standards in samples from 117 to 209 feet BGS. Difficulty was encountered in abandoning the boring.
1989, Radian Corporation	Basewide investigation of surface soil vapor for potential organic contamination.	All four PRLs were screened for organic contamination. Maximum OVA and HNu® readings were 2 ppmv, at PRL 18.
1990, Radian Corporation	Preliminary Groundwater Operable Unit Remedial Investigation. Installed five piezometers in IC 13 to determine groundwater flow directions and other hydraulic parameters, and to determine whether extraction system in OU C is effectively capturing contaminated groundwater.	Determined that extraction system is only partially capturing contaminated groundwater beneath OU C.

(Continued)

TABLE 5.5-1. (Continued)

Year, Contractor	Scope of Investigation	Key Findings
1993, CH2M HILL	Preliminary Assessment of OU C	Through a records review, site visits, and interviews with base personnel, identified areas to be investigated in OU C.
Ongoing, Jacobs Engineering Group	Remedial Investigation of OU C1	Concentrations of TCE, vinyl chloride, and other VOCs exceeding 100,000 ppbv total HVOCs have been detected in the soil gas north of IC 13. The source of this contamination is probably in OU C1.
Ongoing, Radian Corporation	Groundwater Sampling and Analysis Program to determine groundwater contaminant concentrations	High concentrations of VOCs (>10,000 μg/L) have been detected moving south beneath IC 13. The source of contamination is probably in OU C1. Dichlorobenzene detected in MWs 33S, 128, and 129 from 1984 until 1988.

TABLE 5.5-2. DATA QUALITY OBJECTIVES FOR PRLS 18 AND 19

Problem Statement

Burned debris and other solid and hazardous waste may have been buried in pits at PRLs 18 and 19.

Decision to be Made

- Determine if the burial pits exist.
- Determine if contaminants are present in the pits.
- Determine if any contaminants in groundwater at MW-61 originate at PRL 18.
- Determine location priority.

Inputs to the Decision

Level II/III data for soil gas; Level III for inorganic constituents and SVOCs in soil.

Boundaries of the Study

Soil gas samples from 20 to 40 feet BGS and soil samples from 10 to 20 feet BGS collected in the middle of the pits.

Decision Rule

- If physical evidence of wastes or disturbed soil is found, together with analytical data, then the locations were used as burial pits.
- If organic compounds are reported in soil samples, then contaminants from the pit have contaminated the subsurface soil.
- If inorganic species are reported above subsurface background concentrations in soil samples, and the decision process for inorganic species should be applied.
- If VOCs are reported in the soil gas and if concentrations are greater than adjacent or surrounding borings, the contamination may have originated at this location.
- If all data collected are validated, proceed to Data Evaluation DQOs (see Section 4.2.2).

Limits on Uncertainty

Analytical data must meet project specifications for precision and accuracy.

Sample Design

Borings SB7 and SB8 in PRL 18 and SB6 in PRL 19 will be drilled in the center of the potential pit boundaries to determine if the burial pits existed and if the subsurface is contaminated.

(Continued)

TABLE 5.5-2. (Continued)

DATA QUALITY OBJECTIVES FOR PRL 54

Problem Statement Hazardous materials or wastes may have been stored in the bermed area.
Decision to be Made • Determine if contaminants are present. • Determine location priority.
Inputs to the Decision Level II/III data for soil gas; Level III for inorganic species and SVOCs in soil.
Boundaries of the Study Soil gas samples from 20 to 40 feet BGS, and soil samples from 5 to 10 feet BGS.
Decision Rule • If organic contaminants are reported in the soil, then contaminants from the bermed area have contaminated the subsurface soil. • If inorganic species are reported above subsurface background concentrations in soil samples, then the soil may be contaminated and the decision process for inorganic species should be applied. • If VOCs are reported in the soil gas and if concentrations are greater than adjacent or surrounding borings, the contamination may have originated at this location. • If all data collected are validated, proceed to Data Evaluation DQOs (see Section 4.2.2).
Limits on Uncertainty Analytical data must meet project specifications for precision and accuracy.
Sample Design Boring SB5 will be placed in the approximate center of the bermed area to determine if the subsurface is contaminated.

(Continued)

TABLE 5.5-2. (Continued)

DATA QUALITY OBJECTIVES FOR PRL 55

Problem Statement

Acid and lead from lead-acid batteries may have been spilled onto the soil; unknown wastes may have been buried in the location.

Decision to be Made

- Determine if contaminants from the acid storage facility or the pit are present in the subsurface.
- Determine location priority.
- Determine if sediments in the drainage near PRL 55 are contaminated.

Inputs to the Decision

Level II/III data for soil gas; Level III for organic and inorganic contaminants in soil.

Boundaries of the Study

Soil gas samples from 20 to 40 feet BGS, and soil samples from 5 to 10 feet BGS collected around the foundation of the acid storage facility and near the pit. Surface soil samples will be collected in the drainage near PRL 55.

Decision Rule

- If organic contaminants are reported in the subsurface soil, then contaminants from the storage area or pits have contaminated the subsurface soil.
- If surface soil in the drainage ditch is contaminated with the same suite of compounds detected in PRL 55, then run-off from PRL 55 has contaminated the surface sediment.
- If inorganic species are reported above subsurface background concentrations in soil samples, then the soil may be contaminated and the decision process for inorganic species should be applied.
- If soil pH is less than 6, then acid from the lead-acid batteries has contaminated the soil.
- If VOCs are reported in the soil gas and if concentrations are greater than adjacent or surrounding borings, the contamination may have originated at this location.
- If all data collected are validated, proceed to Data Evaluation DQOs (see Section 4.2.2).

Limits on Uncertainty

Analytical data must meet project specifications for precision and accuracy.

Sample Design

Borings SB1 and SB2 will be placed near previous boring locations where solvent odors were noted and adjacent to the potential former disposal pit locations (as indicated in aerial photographs).

(Continued)

TABLE 5.5-2. (Continued)

DATA QUALITY OBJECTIVES FOR THE FORMER GAS STATION

Problem Statement

Gasoline and/or diesel fuel may have leaked from underground tanks or associated piping.

Decision to be Made

- Determine if leaks in the tank or piping have contaminated the soil with TPH or organic lead.
- Determine if the soil gas is contaminated with aromatic VOCs (AVOCs).
- Determine location priority.

Inputs to the Decision

Geophysics to determine appropriateness of location; Level II/III data for soil gas; Level III for TPH, BTEX, and organic lead in soil.

Boundaries of the Study

Soil gas samples from 20 to 40 feet BGS, and soil samples from 10 to 30 feet BGS.

Decision Rule

- If petroleum hydrocarbons are reported in the soil adjacent to and/or beneath the tanks, leaks from the tanks have contaminated the subsurface.
- If organic lead is reported in soil samples, then leaks from the tanks have contaminated the subsurface.
- If AVOCs are reported in the soil gas and if concentrations are greater than in surrounding borings, the contamination may have originated at this location.
- If all data collected are validated, proceed to Data Evaluation DQOs (see Section 4.2.2).

Limits on Uncertainty

Analytical data must meet project specifications for precision and accuracy.

Sample Design

Borings SB3 and SB4 will be placed adjacent to the tanks and piping as located with geophysics.

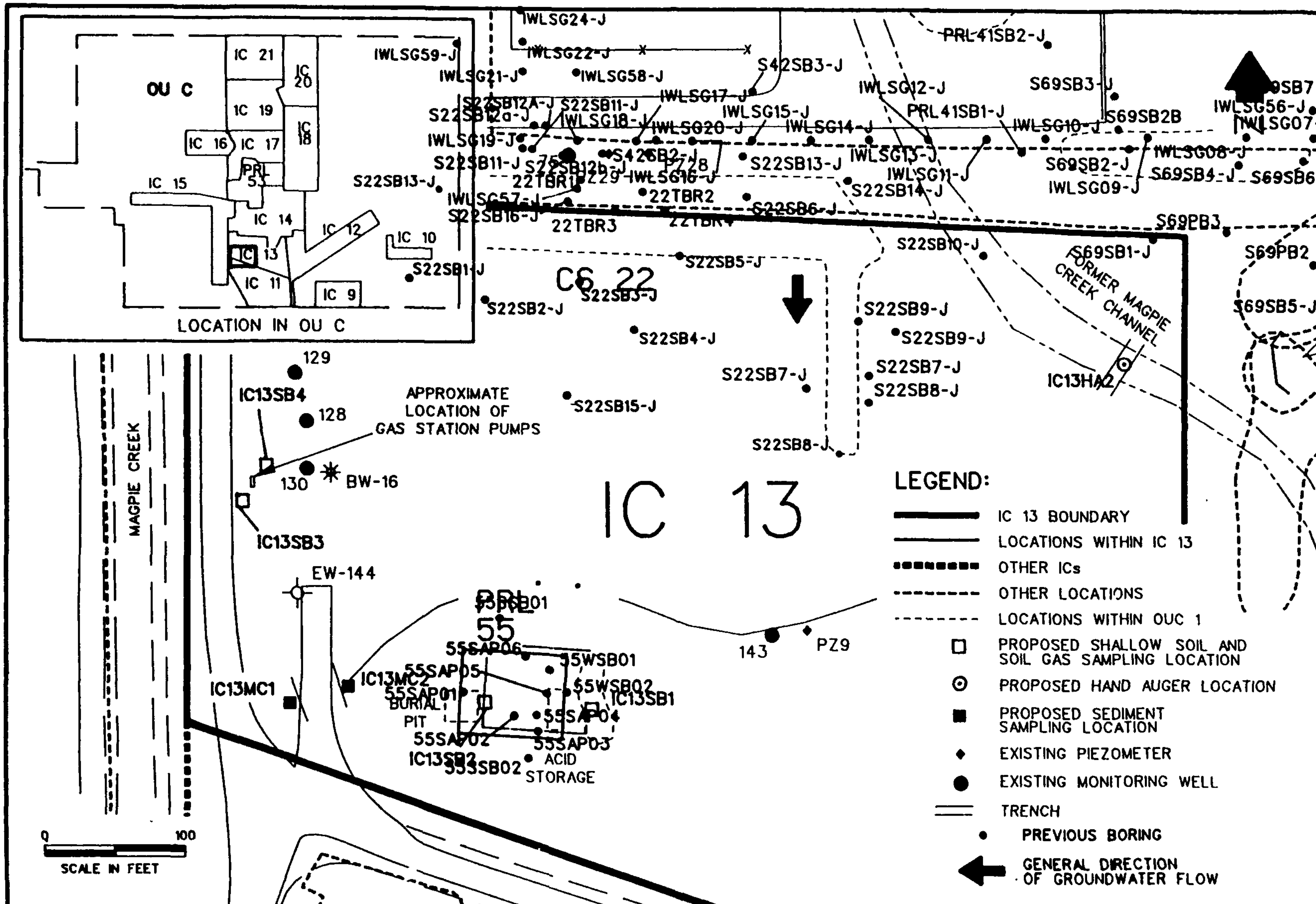
(Continued)

TABLE 5.5-2. (Continued)

DATA QUALITY OBJECTIVES FOR FORMER MAGPIE CREEK CHANNEL

Problem Statement Contaminants in the creek before it was channelized may have contaminated creek sediments and the subsurface.
Decision to be Made • Determine if contaminants are present in the former creek channel. • Determine location priority.
Inputs to the Decision Trenching to determine appropriateness of sampling locations; Level III for organic and inorganic contaminants in soil.
Boundaries of the Study Soil samples from 0 to 3 feet below the old creekbed.
Decision Rule • If organic contaminants are reported in the soil, then contaminants from the creekbed have contaminated the subsurface soil. • If inorganic species are reported above subsurface background concentrations in soil samples, then the soil may be contaminated and the decision process for inorganic species should be applied. • If all data collected are validated, proceed to Data Evaluation DQOs (see Section 4.2.2).
Limits on Uncertainty Analytical data must meet project specifications for precision and accuracy.
Sample Design Two trenches will be dug in IC 13 to locate the former channel of Magpie Creek; trench locations were selected from aerial photographs. Hand augers HA1 and HA2 will be drilled within the former creekbed.

NOTE: All acronyms are defined on the acronyms list at the beginning of the SAP.



Overlay A. Previous Sampling Locations

Figure 5.5-2. Proposed Sampling Locations at IC 13 (Western Portion)

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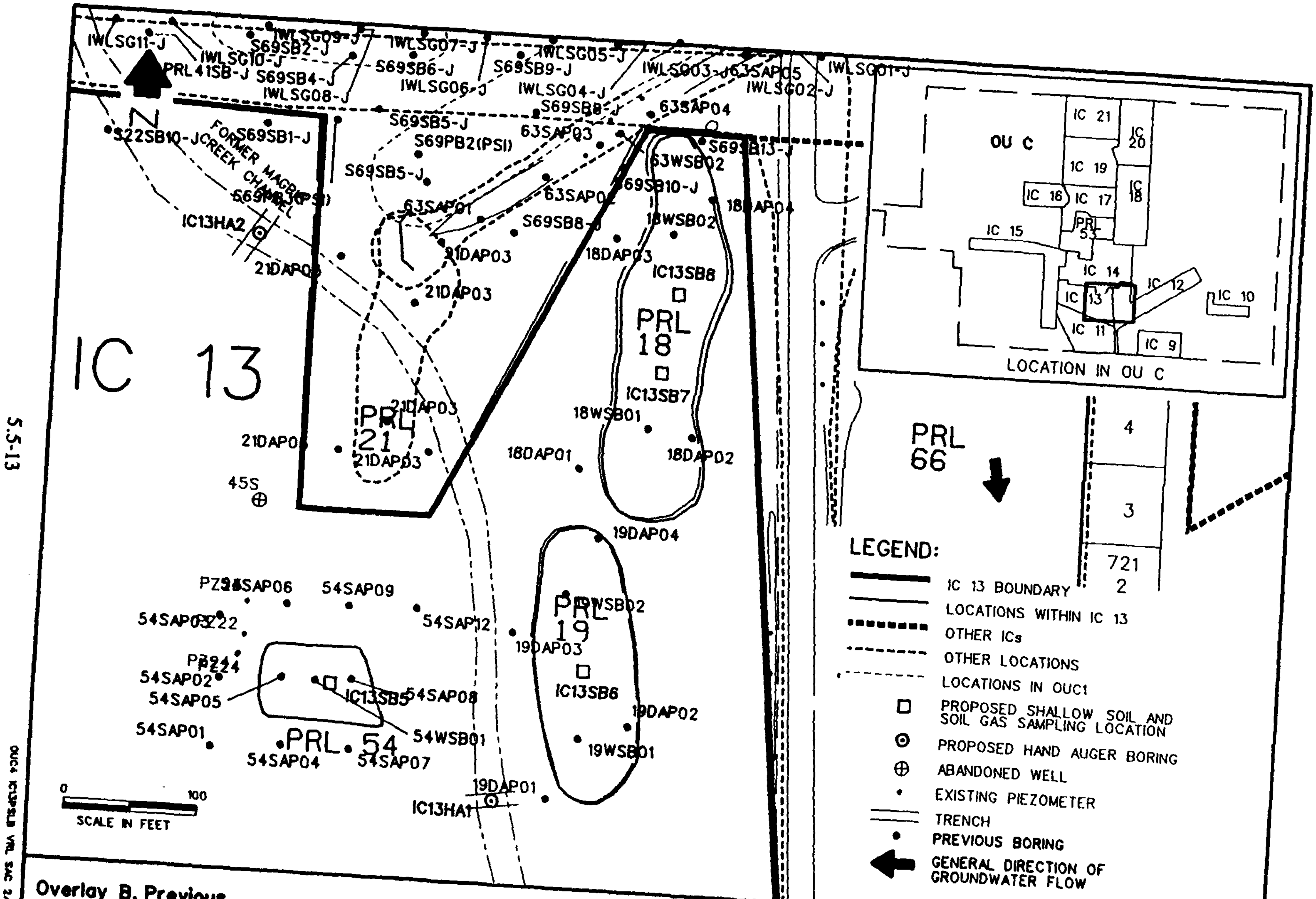

Figure 5.5-3. Proposed Sampling Locations at IC 13 (Eastern Portion)

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TABLE 5.5-3. SAMPLING AND ANALYSIS MATRIX FOR IC 13

Location:	PRL 18	PRL 19	PRL 54	PRL 55			Former Magpie Creek Channel	Former Gas Station
Potential Contaminants of Concern:	VOCs, SVOCs, Inorganic species	VOCs, SVOCs, Inorganic species	Unknown	Acids, VOCs, TPH, SVOCs, Inorganic species, Unknown others			TPH, SVOCs, Inorganic Species	TPH, BTEX, Organic lead, VOCs
Sampling location:	Borings SB7-SB8	Boring SB6	Boring SB5	Boring SB1	Boring SB2	Surface Scrapes MC1[a]-MC2[a]	Hand Augers HA1-HA2	Borings SB3[b]-SB4
Sample Depth and Analytical Method:	(10') ModSW8015/3550, ModSW8015/5030, SW8270, SW6010	(10') ModSW8015/3550, ModSW8015/5030, SW8270, SW6010	(5') SW8270, SW6010, ModSW8015/3550, ModSW8015/5030	(5') SW8270, SW9045, SW6010	(5') ModSW8015/3550, ModSW8015/5030, SW8270, SW9045, SW6010	(0-0.25') SW6010, ModSW8015/3550	(creekhed surface) SW6010, ModSW8015/3550, SW8270	(10') ModSW8015/3550, ModSW8015/5030, HML 338, SW8270
	(15-25') FGC	(15-25') FGC	(10') SW6010, ModSW8015/3550, ModSW8015/5030, SW8270	(10') SW8270, SW9045, SW6010	(10') SW8270, ModSW8015/3550, ModSW8015/5030, SW6010, SW9045	(1') SW8270	(3' below creekbed) SW6010, ModSW8015/3550, SW8270	(15-25') FGC
	(20') ModSW8015/3550, ModSW8015/5030, SW8270, SW6010	(20') ModSW8015/3550, ModSW8015/5030, SW8270, SW6010	(15-25') FGC	(15-25') FGC	(15-25') FGC			(20') ModSW8015/3550, ModSW8015/5030, HML 338, SW8270
	(35-45') FGC	(35-45') FGC	(35-45') FGC	(35-45') FGC	(35-45') FGC			(30') ModSW8015/3550, ModSW8015/5030, HML 338, SW8270
								(35-45') FGC

[a] 5:1 composite samples of creek sediments.
[b] Two samples will be collected for bulk density analysis (ASTM 2937) in different soil types.

FGC = Screening analysis of soil gas for commonly detected VOCs with on-site chromatograph.

NOTE: Matrix represents the minimum number of samples to be collected in each horizon.
FGC analyses will be confirmed with 10% TO-14 analysis.
Specific sample depths will be determined in the field using the sampling criteria specified in Section 4.
All acronyms are defined on the acronym list at the beginning of the SAP.

TABLE 5.5-4. SAMPLING AND FIELD SPECIFICATIONS FOR IC 13

Boring/Location Name	Reference Point	Distance	Maximum Depth Interval (ft BGS)
Surface Scrapes			
MC1	MW-143	48'S, 343'W	1
MC2	MW-143	37'S, 301'W	1
Borings			
SB1	MW-143	51'S, 126'W	45
SB2	MW-143	47'S, 204'W	45
SB3	MW-143	93'N, 377'W	45
SB4	MW-143	118'N, 378'W	45
SB5	PZ 23	55'S, 65'E	45
SB7	PZ 23	187'N, 299'E	45
SB8	PZ 23	244'N, 310'E	45
Hand Augers			
HA1	PZ-23	136'S, 190'E	3[a]
HA2	MW-143	194'N, 251'E	3[a]

[a] Three feet below the former creekbed surface.

5.6 Field Sampling Plan for Investigation Cluster (IC) 14 (Potential Release Locations [PRLs] 17, 20, 21, L-7B, 63, 64, 66B, and portions of the Industrial Wastewater Treatment Plant [IWTP])

Investigation Cluster 14 comprises PRLs 17, 20, 21, 63, 64, 66B, and L-7B (Figure 5.6-1). The IC is located in the southern portion of Operable Unit (OU) C.

Potential Release Location 17 was reportedly used as a burial pit for burned debris from the burning pit at Confirmed Site (CS) 22 and the incinerator at CS 31 in OU B. It may have operated in the late 1950s (CH2M HILL, 1993). Part of PRL 17 is beneath an aeration tank and two blending tanks, which are part of the IWTP.

Potential Release Locations 20 and 21 were reportedly used as burial pits for industrial sludges in the mid-1950s. Potential Release Location 20 is located partly beneath the Groundwater Treatment Plant (GWTP). During excavation for construction of the GWTP, buried debris was uncovered between PRLs 20 and 21.

Potential Release Location L-7B is a portion of the Industrial Wastewater Line (IWL). It includes the main line carrying wastewater from facilities throughout McClellan Air Force Base (AFB) to the IWTP; in PRL L-7B, this main line runs east-west. The PRL also includes the southernmost portion of an IWL connector line from the hush houses in ICs 18 and 20.

Building 722 has four sumps on its west side to collect hydraulic oils and washwater from the floors of the maintenance bays. These sumps were connected to a fuel oil/water separator on the northwest corner of the building. This separator was installed in about 1960 and was equipped with an overflow valve at the surface (Jeffrey, 1993). This separator and the sumps were reportedly connected to the IWL in the 1970s.

Potential Release Locations 63 and 64 are unlined ditches behind the hush houses of Building 722. Both locations may have received discharges of aircraft fuel and oils. Both ditches trend northeast to southwest and collect surface runoff into storm drains, which empty into Magpie Creek north of PRL 28.

Potential Release Location 66B is an unlined drainage area west of the hush houses in Building 722. Before the IWTP was installed in 1974, this area received all surface runoff from testing and maintenance operations in Building 722; this runoff may have contained aircraft fuel and oils. Currently, French drains in the front (east) of the building collect runoff and reportedly discharge to the IWL.

Investigation Cluster 14 also includes those portions of the IWTP not already included in the OU C1 investigation; primarily, these are surface spill areas and aboveground tanks. In 1987, the aboveground free oil tank overflowed, spilling oil onto the ground surface. At least a portion of the contaminated soil was removed (CH2M HILL, 1993). Also, two 8,000-gallon chemical/waste oil tanks were located beneath the IWTP until 1989, when they were removed. These tanks were reportedly located near Buildings 714 and 715; however, on at least one drawing they are shown to be located near Building 718. Borings were drilled during the OU C1 RI near Buildings 715 and 718, but not in the Building 714 area.

Before Magpie Creek was channelized and its route altered (between 1943 and 1945), it flowed through what is now IC 14. In the 1940s, industrial wastewater from the eastern portion of McClellan AFB (OU A) was discharged to Magpie Creek; according to CH2M HILL (1993, page 1.10-14), as much as 500 gallons of oil a day were removed from Magpie Creek at the skimming basin (PRL 28, downstream in IC 15) in 1943 and 1944. Some of these contaminants could have remained in the creekbed or leaked into the subsurface. Sometime after the course of the creek was altered, the old creekbed was filled.

Although not a source of contamination, a possible conduit for contaminant migration is located within IC 14: Base Well (BW) 6. Base Well 6, an inactive water supply well, is reportedly located near Building 714. Ludorff and Scalmanini (1984) describe the well as an "old farm well," and state no information is available about the well depth, screen interval, or abandonment methods. If the well was not properly abandoned, it may provide a means for groundwater contaminants to migrate deeper. Base Well 6 will be investigated by the McClellan AFB Well Abandonment Team to determine what future action, if any, should be taken. This well is not scheduled in the current abandonment effort, but will be investigated in a subsequent phase.

Previous investigations in IC 14 are summarized in Table 5.6-1.

5.6.1 Data Quality Objectives

The data quality objectives for this stage of the remedial investigation (RI) in IC 14 are shown on Table 5.6-2.

5.6.2 Sampling Plan

Proposed sampling locations are shown on Figures 5.6-2 and 5.6-3; previous sampling locations are shown on Overlays A and B. The sampling and analytical matrix for IC 14 is shown in Table 5.6-3; field specifications for sampling locations are included in Table 5.6-4.

A geophysical survey will be used to locate BW-6. A determination can then be made of the need for further action (abandonment) at the well.

Rationale and specific objectives for sampling locations are outlined below.

Borings SB1 through SB6, located along the north/south connector lines of the IWL, are intended to determine whether contaminants have leaked from the IWL into the subsurface. (Borings were drilled along the main east/west line in 1993 during the OU C1 RI.) Borings SB1 through SB6 will be drilled at the locations of manholes and areas of known or suspected leaks. The depth of the IWL is assumed to be approximately 10 feet BGS.

Where the 1993 IWL investigation indicated a "high" or "moderate" potential for leakage, borings will be spaced 100 feet apart (Borings SB1 and SB2). Where the 1993 investigation indicated a blockage in the line (a location where cracks were previously identified), a boring (SB3) will be drilled to groundwater. Soil and soil gas samples will be collected in this boring. Boring SB3 will be converted to a groundwater monitoring well to determine whether contaminants have migrated to groundwater and to help determine groundwater flow directions in the area.

Samples will be collected from 10 to 85 feet BGS for analysis of inorganic species near the section of the IWL that was plugged and cracked. Samples will be analyzed sequentially with depth; the sample at 10 feet will be analyzed first. If the shallowest sample

contains inorganic species above subsurface background concentrations, the next deepest sample will be analyzed. If concentrations in the shallowest sample are not above background, the deeper samples collected for inorganic analysis will not be analyzed. This procedure will be followed for each of the sampling intervals. Soluble metal concentrations will be determined in the deepest sample analyzed (see Section 4.3.2). Groundwater will be analyzed for inorganic species to support the Groundwater OU RI/FS.

Boring SB11, located next to the fuel oil/water separator near the northwest corner of Building 722, will help determine whether leaks or discharges from the separator have contaminated the surface and/or subsurface soil. Borings SB7 through SB10 are located next to the sumps along the west side of Building 722; they are intended to ascertain whether the sumps have leaked and contaminated the subsurface.

Borings SB12 through SB17 are intended to determine whether the contents of the reported pits at PRLs 17, 20, and 21 have contaminated the subsurface. The borings are located within the pits or as close to them as possible. Where possible, borings were placed in the estimated center of the pit along its long axis. However, because parts of the pits at PRLs 17 and 20 may be underneath structures, borings were also placed at the edge of the structure at the point closest to the estimated pit boundary. In addition to collecting samples for analysis, the soil core will be inspected for visual indication of wastes or disturbed soil to determine whether or not the locations were used as burial pits for contaminants. Soil and soil gas samples will help determine whether any contaminants in the pits have migrated below the pits.

Boring SB18 is within the oil surface spill area in the IWTP. This boring will determine whether oil that spilled from the aboveground tank has contaminated the subsurface soil. Compounds associated with oil (petroleum hydrocarbons, volatile and semivolatile organic compounds, polycyclic aromatic hydrocarbons, polychlorinated biphenyls, and dioxins/furans) are the suspected contaminants of concern (COCs).

Boring SB19 will be drilled in the area of the underground chemical/waste oil tank (Tanks 714) at the IWTP to determine whether the tank leaked and contaminated the subsurface. In addition to the standard suite of COCs listed in Table 4-11 in Section 4.3.2, samples will be collected for analysis of polycyclic aromatic hydrocarbons (associated with waste oil). Because the former location of the tank near Building 714 is not precisely known, a record search of Civil Engineering (CE) construction diagrams will be completed prior to drilling the boring to determine its former location. If CE files indicate that the tank is not located near Buildings 714, then the boring will not be drilled.

Hand augers HA5 through HA11 will be drilled in the ditches in PRLs 64 and 63 to determine whether any contaminants transported in the ditches have contaminated the sediments. Hand augers HA1 through HA4 are located in the drainage swales of PRL 66B to determine whether contaminants from engine testing and maintenance have run off into the drainage and contaminated the sediments.

Bulk density samples will be collected from three different soil types in Boring SB3 to provide information for vadose zone modeling and for evaluation of remedial alternatives.

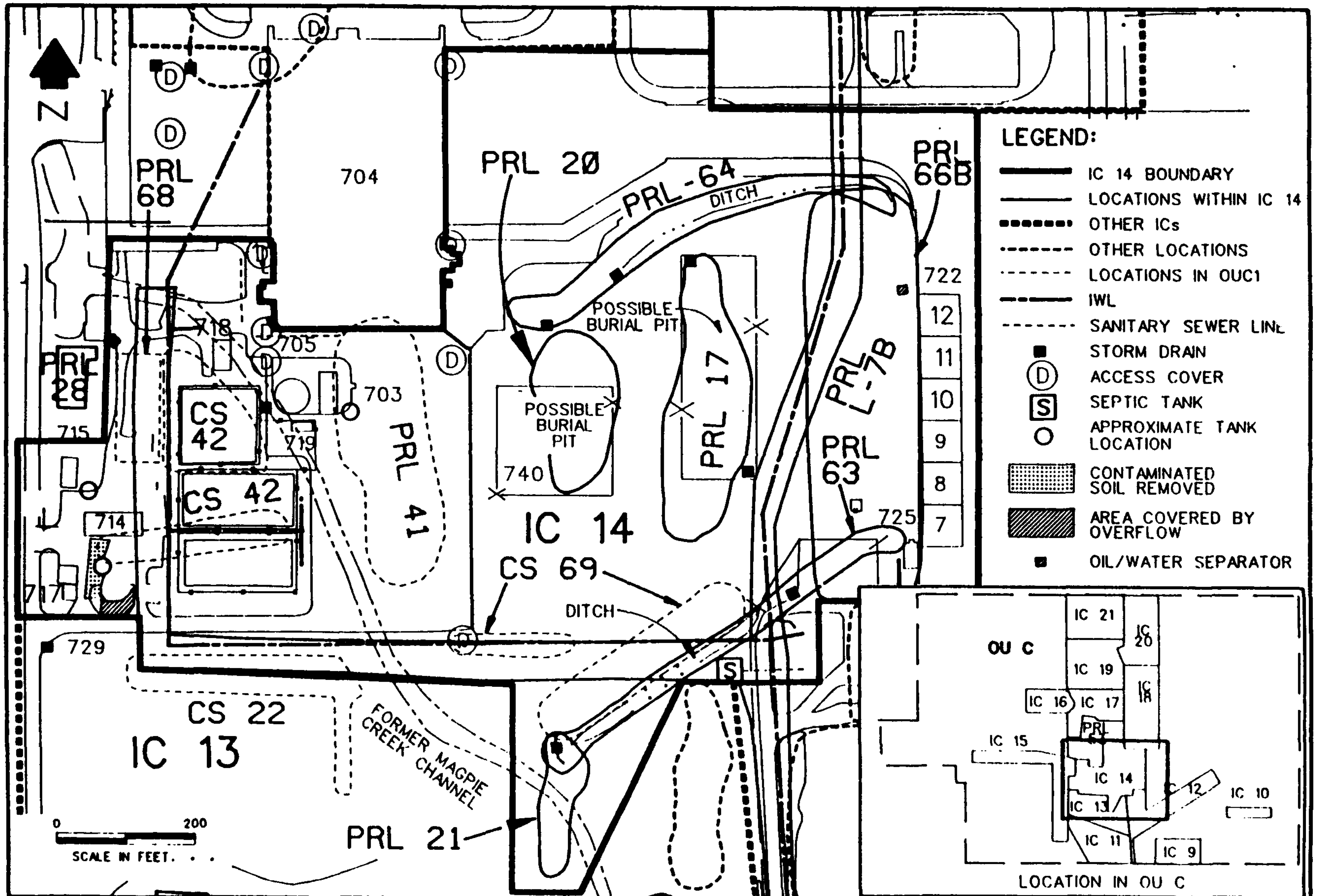


Figure 5.6-1 Potential Discharge Areas in IC 14

OUC2 IC14PDA VRL SAC 9/2/93

TABLE 5.6-1. PREVIOUS INVESTIGATIONS AT IC 14

Year, Contractor	Scope of Investigation	Key Findings
1985, McLaren Environmental Engineers	Investigation of potential contamination. PRLs 17, 20, and 21 were delineated by GPR. A total of 37 borings (both shallow and deep) were drilled at PRLs 17, 20, 21, 63, and 64. Two samples each from PRLs 17, 20, and 21 were analyzed for VOCs. At PRLs 63 and 64, two samples each were analyzed for priority pollutants; two more were analyzed for VOCs at each.	PRL 17: Borings encountered only undisturbed soil profiles; no wastes were encountered. Low levels of benzene and dichloromethane (<150 μg/kg) were reported at 31 feet BGS. PRLs 20 and 21: No visible contamination or wastes encountered in 11 of 12 borings. In 21DAP02, 5 feet of fill material was encountered. Low levels (<300 μg/kg) of VOCs were reported in samples from 30 feet BGS from both locations. PRLs 63 and 64: 2 deep and 15 shallow borings were drilled from the two locations. No waste was encountered in any boring. Samples indicated no priority pollutant compounds.
1987 and 1988, McClellan AFB	After the free oil separation tank at the IWTP overflowed, three samples were collected of the soil in the spill area.	Diesel fuel and lead, arsenic, cadmium, nickel, chromium, copper, zinc, and silver above subsurface background were detected in soil samples. The PA report does not indicate whether the soil was removed.
1987, McClellan AFB	An investigation conducted at PRL 20 before construction of the GWTP included drilling borings and collecting soil samples.	Borings encountered airplane parts, paint cans, paint, and garbage. Soil samples yielded elevated levels of lead. Exact boring locations and analytical results are not known.
1988, EG&G Idaho	Investigation and inspection of the IWL basewide, to determine system integrity and compatibility of piping with wastewater flowing through it.	Main line in PRL L-7B was found to be crushed and leaking; leaks were repaired with Insituform® grout. Leaks were reported along the connector line coming from the north. The line to Building 725 was not inspected.
1989, Radian Corporation	Basewide investigation of surface soil vapor for potential organic contamination.	Maximum OVA and HNu® readings at the seven PRLs in IC 14 were 3 ppmv, both taken at PRL 20 outside the GWTP.

(Continued)

TABLE 5.6-1. (Continued)

Year, Contractor	Scope of Investigation	Key Findings
1993, CH2M HILL	Preliminary Assessment of OU C	Identified areas to be investigated in OU C through records review, site visits, and interviews with base personnel.
1993, Jacobs Engineering Group	Inspection and repair of more than 22,000 feet of the IWL.	Found a blockage of the IWL north of MH 4 in OU C. Rated the section of the line north of the blockage as having a high potential for leakage.
Ongoing, Jacobs Engineering Group	Remedial Investigation of OU C1	Concentrations of TCE, vinyl chloride, and other volatile organic compounds exceeding 100,000 ppbv have been detected in the soil gas in and around OU C1. The source of this contamination is probably in OU C1. Lead has also been reported above the subsurface background concentrations at CS 69.
Ongoing, Radian Corporation	Groundwater Sampling and Analysis Program to determine groundwater contaminant concentrations	A plume of contaminated groundwater has been identified moving south beneath IC 14. The source of contamination is probably in OU C1.

NOTE: All acronyms are defined on the acronym list at the beginning of the SAP.

TABLE 5.6-2. DATA QUALITY OBJECTIVES FOR PRLs 17, 20 and 21

Problem Statement

Industrial sludges, hazardous waste, or incinerator ash may have been disposed into the pits at PRLs 17, 20, and 21.

Decision to be Made

- Determine if the burial pits exist.
- Determine if contaminants are present in the pits.
- Determine the location priority.

Inputs to the Decision

Level II/III data for soil gas; Level III for organic and inorganic constituents in soil.

Boundaries of the Study

Soil gas samples from 20 to 40 feet BGS; soil samples from 5 to 15 feet BGS collected in the middle of the pits.

Decision Rule

- If physical evidence of wastes or debris is found, together with positive analytical data, then the locations were used as burial pits.
- If organic compounds are reported in soil samples, then contaminants in the pit have contaminated the subsurface soil.
- If inorganic species are reported above subsurface background concentrations in soil samples, then the subsurface may be contaminated, and the decision process for inorganic species should be applied.
- If VOCs are reported in the soil gas and if concentrations are greater than adjacent or surrounding borings, the contamination may have originated at this location.
- If all data collected are validated, then apply Data Evaluation DQOs (see Section 4.2.2).

Limits on Uncertainty

Analytical data must meet project specifications for precision and accuracy.

Sample Design

Borings SB12 and SB13 (PRL 20), SB14–SB16 (PRL 17) and SB17 are placed as close to the approximate center and parallel to the long axis of the pits.

(Continued)

TABLE 5.6-2. (Continued)

DATA QUALITY OBJECTIVES FOR PRLS 63 AND 64

Problem Statement Contaminants have been disposed to the drainage ditches at PRLs 63 and 64.
Decision to be Made • Determine if petroleum hydrocarbons, SVOCs, or inorganic species have contaminated the ditch sediments and the subsurface. • Determine the location priority.
Inputs to the Decision Level III data for organic and inorganic species in soil.
Boundaries of the Study Soil samples will be collected from the surface to 5 feet below the ditch bottom within the drainage ditches.
Decision Rule • If petroleum hydrocarbons or SVOCs are reported in sediment or subsurface soil samples, then the sediments or subsurface soil have been contaminated. • If inorganic species above background levels are reported in sediment or soil samples, the soil may have been contaminated and the decision process for inorganic species should be applied. • If all data collected are validated, then apply Data Evaluation DQOs (see Section 4.2.2).
Limits on Uncertainty Analytical data must meet project specifications for precision and accuracy.
Sample Design Hand augers HA5–HA9 (PRL 64) and HA10–HA14 (PRL 63) will be placed near storm drains and at 100-foot intervals in the ditches.

(Continued)

TABLE 5.6-2. (Continued)

DATA QUALITY OBJECTIVES FOR PRL 66B

Problem Statement Contaminants have been disposed to the drainage areas at PRL 66B. Sumps and the fuel oil/water separator behind Building 722 may have leaked and contaminated the subsurface.
Decision to be Made • Determine if petroleum hydrocarbons or SVOCs have contaminated the surface or subsurface soils. • Determine if leakage from the oil/water separator or the sumps has contaminated the subsurface. • Determine if the soil gas is contaminated with VOCs. • Determine the location priority.
Inputs to the Decision Level III data for organic and inorganic species in soil; Level II/III data for soil gas.
Boundaries of the Study Soil gas samples from 20 to 40 feet BGS; soil samples will be collected at the surface to 20 feet BGS.
Decision Rule • If petroleum hydrocarbons or other SVOCs are reported in sediment or subsurface soil samples, then the sediments or subsurface soil have been contaminated. • If inorganic species above background levels are reported in sediment or soil samples, the soil may have been contaminated and the decision process for inorganic species should be applied. • If VOCs are reported in soil gas, and if concentrations decrease with distance horizontally from the PRL, then the VOC contamination most likely originates at the PRL. • If all data collected are validated, then apply Data Evaluation DQOs (see Section 4.2.2).
Limits on Uncertainty Analytical data must meet project specifications for precision and accuracy.
Sample Design Hand augers HA1–HA4 will be placed in topographically low areas of PRL 66B. Borings SB7–SB10 will be placed next to the sumps west of Building 722. Boring SB11 will be placed next to the fuel oil/water separator.

(Continued)

TABLE 5.6-2. (Continued)

DATA QUALITY OBJECTIVES FOR SOIL AND SOIL GAS AT PRL L-7B

Problem Statement Wastewater in the IWL may have leaked and contaminated the subsurface.
Decision to be Made • Determine if VOCs have leaked from the IWL and contaminated the soil gas and soil. • Determine the location priority.
Inputs to the Decision Level II/III data for VOCs in soil gas; Level III data for organic compounds and inorganic species in soil.
Boundaries of the Study Borings will be placed along the IWL. Soil gas samples will be collected from about 20 to 100 feet BGS; soil samples from 10 to 85 feet BGS.
Decision Rule • If VOCs are reported in soil gas along the IWL, and if concentrations decrease with distance from the IWL horizontally, then the VOC contamination most likely originates at the IWL. • If suites of VOCs in deep soil gas (40 to 60 feet BGS) are the same as in shallow soil gas (10 to 20 feet BGS), then VOCs from the IWL have most likely migrated vertically. • If inorganic species are reported above subsurface background concentrations in soil samples, then inorganic contaminants may have leaked from the IWL and the decision process for inorganic species should be applied. • If all data collected are validated, then apply Data Evaluation DQOs (see Section 4.2.2).
Limits on Uncertainty Analytical data must meet project specifications for precision and accuracy.
Sample Design Borings SB1–SB6 will be placed along the IWL either in areas of known or suspected leaks (SB1–SB2) and/or at manhole locations (SB3–SB6).

(Continued)

TABLE 5.6-2. (Continued)

DATA QUALITY OBJECTIVES FOR GROUNDWATER BENEATH IC 14

Problem Statement A plugged and cracked section of the IWL may have released contaminants into the subsurface. Data on groundwater flow directions and contaminant migration in western OU C are sparse.
Decision to be Made • Determine groundwater flow directions. • Determine if the groundwater beneath the location is contaminated. • Determine the location priority.
Inputs to the Decision Level III data for groundwater. Previous groundwater flow and contaminant data.
Boundaries of the Study Groundwater samples from the A monitoring zone.
Decision Rule • Contaminants from the location have contaminated the groundwater if all of the following are true: — Organic compounds or inorganic species above background are reported in groundwater samples downgradient of the location, — Those suites of compounds or species are also reported in soil gas or soil beneath the location, and — Those compounds or species are not reported or are reported at lower concentrations in upgradient samples. • If all data collected are validated, then apply Data Evaluation DQOs (see Section 4.2.2).
Limits on Uncertainty Analytical data must meet project specifications for precision and accuracy.
Sample Design Boring SB3 will be drilled to groundwater and sampled. The boring will be converted to a monitoring well, developed, and resampled.

(Continued)

TABLE 5.6-2. (Continued)

DATA QUALITY OBJECTIVES FOR TANK 714

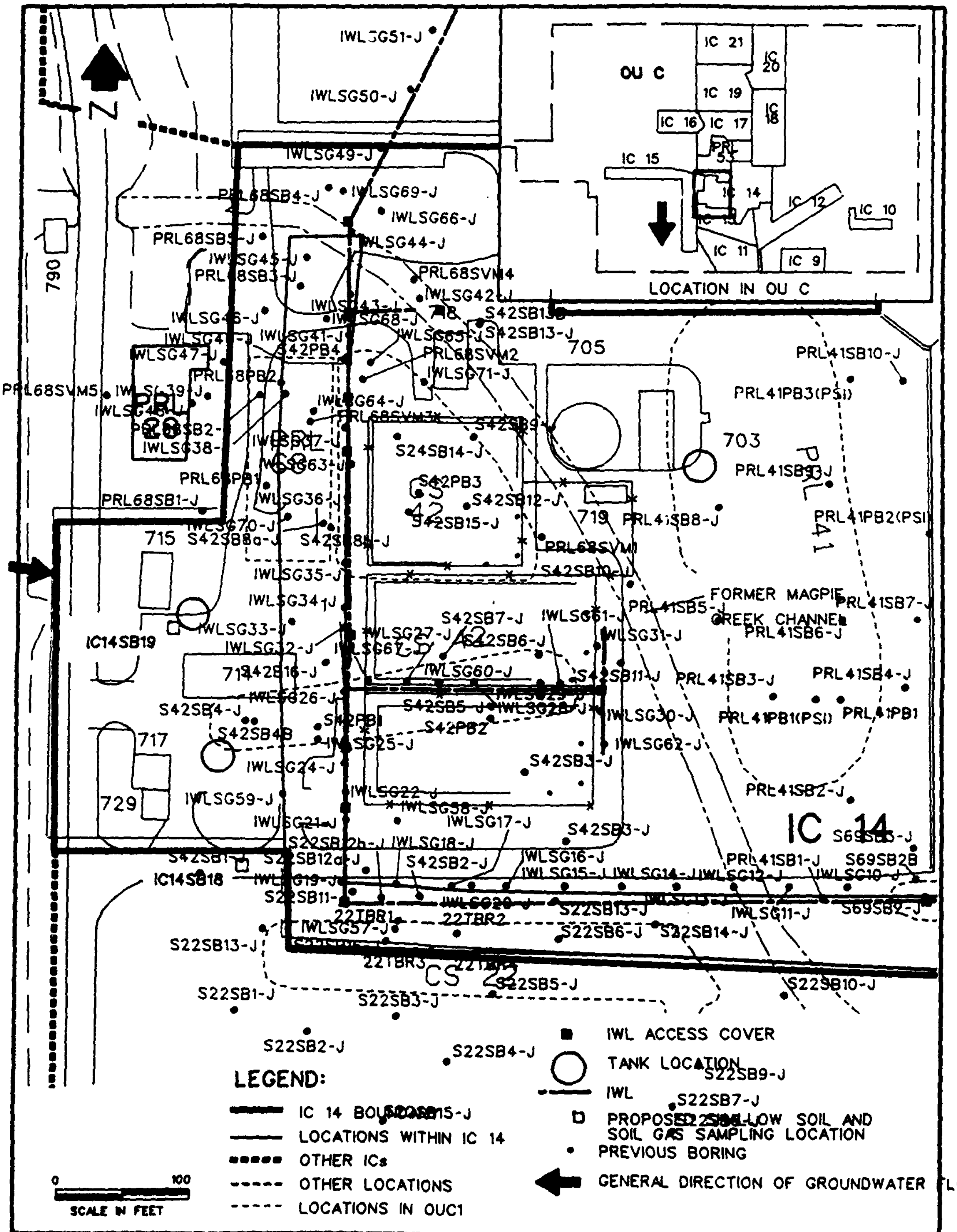
Problem Statement Waste chemicals or oil in the waste oil tank may have leaked and contaminated the subsurface.
Decision to be Made • Determine if leaks in the tank or piping have contaminated the soil. • Determine if the soil gas is contaminated with VOCs from the tank. • Determine the location priority.
Inputs to the Decision Geophysical data to determine if boring location is appropriate; Level II/III data for VOCs in soil gas; Level III data for SVOCs and petroleum hydrocarbons in soil.
Boundaries of the Study Soil gas samples from 20 to 40 feet BGS, and soil samples from 10 to 20 feet BGS.
Decision Rule • If organic compounds are reported in the soil adjacent to and/or beneath the tank, leaks from the tank have contaminated the subsurface. • If inorganic species are reported in soil samples, then leaks from the tank may have contaminated the subsurface and the decision process for inorganic species should be applied. • If VOCs are reported in the soil gas and if concentrations are greater than in adjacent or surrounding borings, the contamination may have originated at this location. • If all data collected are validated, proceed to Data Evaluation DQOs (see Section 4.2.2).
Limits on Uncertainty Analytical data must meet project specifications for precision and accuracy.
Sample Design Boring SB19 will be placed adjacent to the estimated location of tank and piping.

(Continued)

TABLE 5.6-2. (Continued)

DATA QUALITY OBJECTIVES FOR FREE OIL TANK

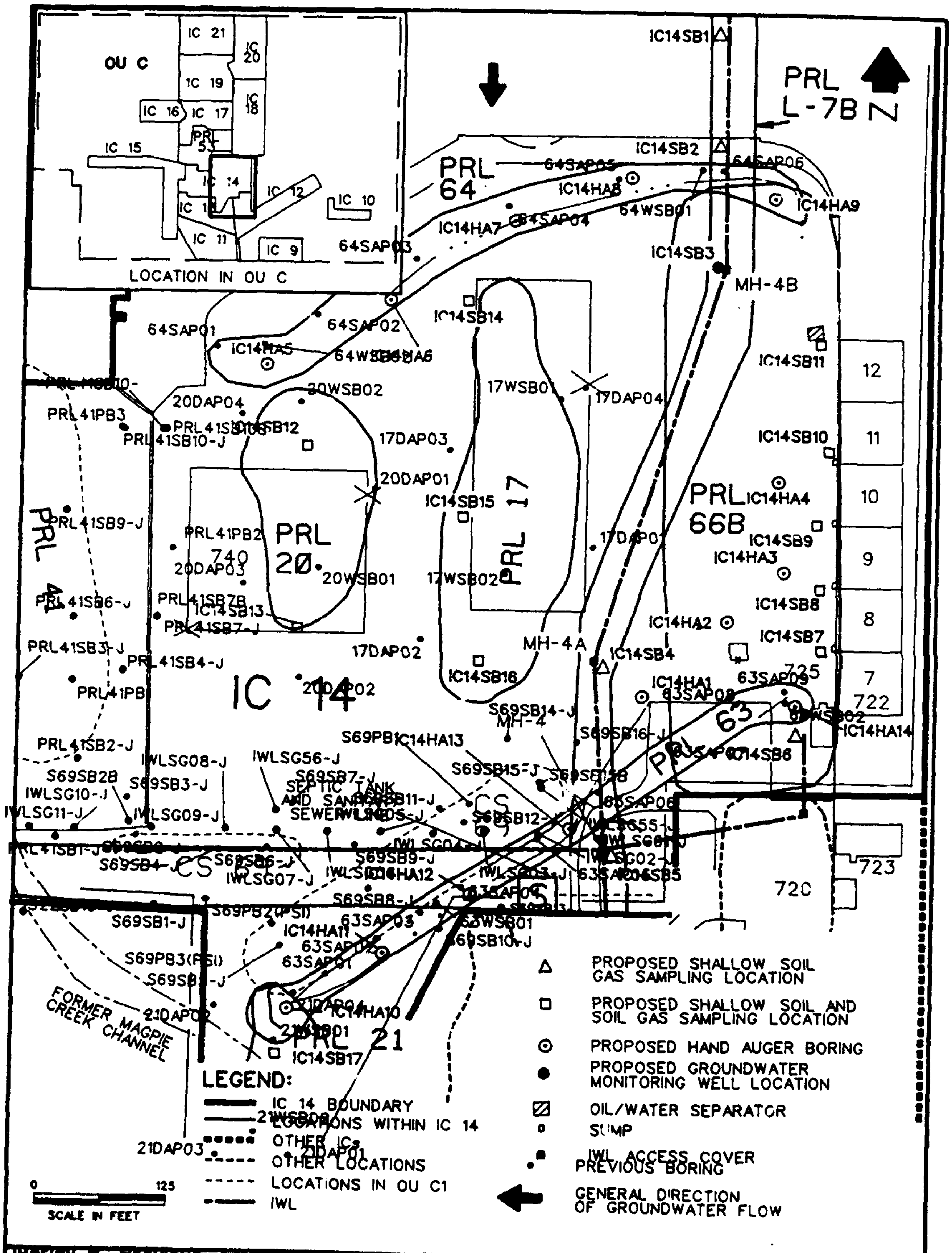
Problem Statement Waste oil from the aboveground free oil tank spilled onto the surface and may have contaminated the surface and subsurface soil.
Decision to be Made • Determine if the surface soil is contaminated with TPH or other SVOCs. • Determine if the soil gas is contaminated with VOCs. • Determine the location priority.
Inputs to the Decision Level II/III data for VOCs in soil gas; Level III data for SVOCs and petroleum hydrocarbons in soil.
Boundaries of the Study Soil gas samples from 20 to 40 feet BGS, and soil samples from surface to 15 feet BGS.
Decision Rule • If organic compounds are reported in or beneath the surface spill area, the spill has contaminated the soil. • If inorganic species are reported in soil samples in or beneath the spill area, then the spill may have contaminated the subsurface and the decision process for inorganic species should be applied. • If VOCs are reported in the soil gas and if concentrations are greater than in adjacent or surrounding borings, the contamination may have originated at this location. • If all data collected are validated, proceed to Data Evaluation DQOs (see Section 4.2.2).
Limits on Uncertainty Analytical data must meet project specifications for precision and accuracy.
Sample Design Boring SB18 will be placed in the approximate center of the spill area.



Overlay A Previous Sampling Locations

Figure 5.6-2 Proposed Sampling Locations at IC 14 (Western Portion)

OUC4 IC14PSLA VRL SAC 2/3/94



Overlay B. Previous Sampling Locations

Figure 5.6-3. Proposed Sampling Locations at IC 14 (Eastern Portion)

TABLE 5.6-3. SAMPLING AND ANALYSIS MATRIX FOR IC 14

Location:	PRL 17	PRL 20	PRL 21	PRL 63	PRL 64	Free Oil Tank
Potential Contaminants of Concern	VOCs, SVOCs, TPH, Inorganic species	VOCs, SVOCs, TPH, Inorganic species	VOCs, SVOCs, TPH, Inorganic species	SVOCs, Inorganic species, TPH	SVOCs, Inorganic species, TPH	Petroleum hydrocarbons, SVOCs, PAHs, VOCs, PCBs, Dioxins/furans
Sampling Location:	Borings SB14–SB16	Borings SB12–SB13	Boring SB17	Hand Augers HA10–HA14	Hand Augers HA5–HA9	Boring SB18
Sample Depth and Analytical Method:	(5′) ModSW8015/3550, ModSW8015/5030, SW8270, SW6010 (15′) ModSW8015/3550, ModSW8015/5030, SW8270, SW6010 (15–25′) FGC (35–45′) FGC	(5′) ModSW8015/3550, ModSW8015/5030, SW8270, SW6010 (15′) ModSW8015/3550, ModSW8015/5030, SW6010, SW8270 (15–25′) FGC (35–45′) FGC	(5′) ModSW8015/3550, ModSW8015/5030, SW8270, SW6010 (15′) ModSW8015/3550, ModSW8015/5030, SW6010, SW8270 (15–25′) FGC (35–45′) FGC	(0–0.25′) ModSW8015/3550, SW6010 (1′) SW8270 (5′) ModSW8015/3550, SW8270	(0–0.25′) ModSW8015/3550, SW6010 (1′) SW8270 (5′) ModSW8015/3550, SW8270	(0–0.25′) ModSW8015/3550, SW6010, E418.1, SW8310, SW8080, SW8280 (1′) SW8270 (5′) ModSW8015/3550, SW8270, E418.1, SW8310, SW8080, SW8280 (15′) ModSW8015/3550, SW8270, E418.1, SW8310 (15–25′) FGC (35–45′) FGC

(Continued)

TABLE 5.6-3. (Continued)

Location:	PRL 66B			PRL L-7B		Tank 714
Potential Contaminants of Concern:	VOCs, SVOCs, TPH, Inorganic species			VOCs, SVOCs, Inorganic species, TPH		VOCs, SVOCs, Inorganic species, TPH, PAHs
Sampling Location:	Hand Augers HA1-HA4	Boring SB11	Borings SB7-SB10	Borings SB1-SB2, SB4-SB6	Boring SB3[e,f]	Boring SB19
Sample Depth and Analytical Method:	(0-0.25') ModSW8015/3550, SW6010 (1') SW8270 (5') ModSW8015/3550, ModSW8015/5030, SW8270	(0-0.25') SW6010, ModSW8015/3550, E418.1 (1') SW8270 (10') ModSW8015/3550, ModSW8015/5030, SW8270, SW6010, E418.1 (15-25') FGC (20') ModSW8015/3550, ModSW8015/5030, SW8270, SW6010, E418.1 (35-45') FGC	(0-0.25') SW6010, ModSW8015/3550 (1') SW8270 (5') ModSW8015/3550, ModSW8015/5030, SW8270, SW6010 (10') ModSW8015/3550, ModSW8015/5030, SW8270, SW6010 (5-25') FGC (35-45') FGC	(15-25') FGC (35-45') FGC	(10') SW8270, SW6010, SW1311/SW6010, SW1311/SW7060, SW1311/SW7471, SW1311/SW7740, SW7060, SW7740, SW7471, E218.6, SW9012, SW9045 (15-25') FGC (20') SW8270, SW6010[b], SW1311/SW6010[c], SW1311/SW7060[c], SW1311/SW7471[c], SW1311/SW7740[c], SW7060[b], SW7740[b], SW7471[b], E218.6, SW9012[b], SW9045 (35-45') FGC (45') SW6010[b], SW8270, SW1311/SW6010[c], SW1311/SW7060[c], SW1311/SW7471[c], SW1311/SW7740[c], SW7060[b], SW7740[b], SW7471[b], E218.6, SW9012[b], SW9045 (55-65') FGC (75-85') FGC (85') SW6010[b], SW8270, SW1311/SW6010[c], SW1311/SW7060[c], SW1311/SW7471[c], SW1311/SW7740[c], SW7060[b], SW7740[b], SW7471[b], E218.6, SW9012[b], SW9045 (groundwater) SW8260[c,d], SW6010D, SW7060D, SW7421D, SW7740D, SW7470D	(10') ModSW8015/3550, SW8270, SW6010, E418.1 (15-25') FGC (20') ModSW8015/3550, SW8270, SW6010, E418.1 (35-45') FGC

(fo ... :s presented on following page.)

TABLE 5.6-3. (Continued)

[a] Three samples will be collected for bulk density analysis (ASTM D2434) in different soil types.
[b] Sample will be analyzed only if previous (uphole) sample contains inorganic species above subsurface background concentrations.
[c] For SW8240 analytes.
[d] The benefits and limitations of Method SW8260 are currently being compared with Methods SW8010 and SW8020. Depending on the outcome of this review, Methods SW8010 and SW8020 may be used instead of SW8260.
[e] Only the deepest sample analyzed for inorganic constituents will be analyzed for soluble concentrations (see Section 4.3.2).
[f] Notify the laboratory that some of the samples are to be analyzed sequentially with depth and that holding times (14 days for SW9012) must be met.

FGC = Screening analysis of soil gas for commonly detected VOCs with on-site chromatograph.

NOTE: Matrix represents the minimum number of samples to be collected in each horizon.
FGC analyses will be confirmed with 10% TO-14 analysis.
Specific sample depths will be determined in the field using the sampling criteria specified in Section 4.
All acronyms are defined on the acronym list at the beginning of the SAP.

TABLE 5.6-4. SAMPLING AND FIELD SPECIFICATIONS FOR IC 14

Boring/Location Name	Reference Point	Distance	Maximum Depth Interval (ft BGS)
Hand Auger			
HA1	Northwest corner of Bldg. 725	7'S, 157'W	5
HA2	Northwest corner of Bldg. 725	79'N, 78'W	5
HA3	Northwest corner of Bldg. 725	126'N, 27'W	5
HA4	Northwest corner of Bldg. 725	214'N, 32'W	5
HA5	Southeast corner of Bldg. 740	257'N, 96'W	5
HA6	Southwest corner of Bldg. 740	321'N, 19'E	5
HA7	Southwest corner of Bldg. 740	399'N, 134'E	5
HA8	Northwest corner of Bldg. 722	153'N, 196'W	5
HA9	Northwest corner of Bldg. 722	134'N, 62'W	5
HA10	Southeast corner of Bldg. 740	65'W, 358'S	5
HA11	Southeast corner of Bldg. 740	22'E, 304'S	5
HA12	Southeast corner of Bldg. 740	103'E, 247'S	5
HA13	Southeast corner of Bldg. 740	195'E, 183'S	5
HA14	Northwest corner of Bldg. 725	14'W, 0'N	5
Borings			
SB1	Southwest corner of Bldg. 772	141'S, 103'W	45
SB2	Northwest corner of Bldg. 722	183'N, 111'W	45
SB3	Northwest corner of Bldg. 722	67'N, 113'W	100
SB4	Northwest corner of Bldg. 725	35'N, 194'W	45
SB5	Northwest corner of Bldg. 720	16'N, 205'W	45
SB6	Southwest corner of Bldg. 725	7'N, 14'W	45
SB7	Northwest corner of Bldg. 725	54'N, 9'E	45
SB8	Northwest corner of Bldg. 725	111'N, 6'E	45
SB9	Northwest corner of Bldg. 725	173'N, 4'E	45
SB10	Northwest corner of Bldg. 725	108'S, 8'W	45
SB11	Northwest corner of Bldg. 722	5'S, 15'W	45
SB12	Southeast corner of Bldg. 740	207'N, 56'W	45
SB13	Southeast corner of Bldg. 740	5'N, 62'W	45
SB14	Southeast corner of Bldg. 740	321'N, 90'E	45
SB15	Southeast corner of Bldg. 740	111'N, 90'E	45
SB16	Southeast corner of Bldg. 740	24'S, 108'E	45
SB17	Piezometer 23	226'S, 103'E	45
SB18	Northwest corner of Bldg. 714	160'S, 44'E	45
SB19	Northwest corner of Bldg. 714	18'N, 7'W	45

5.7 Field Sampling Plan for Investigation Cluster (IC) 15 (Potential Release Locations [PRLs] 28, 60, and P-10)

Investigation Cluster 15 comprises PRLs 28, 60, and P-10, and includes the portion of Magpie Creek from its entry point in southeast IC 15 to Lang Avenue, west of Building 786 (Figure 5.7-1). Investigation Cluster 15 is located in the southwestern portion of Operable Unit (OU) C.

Potential Release Location 28 is an oil skimming basin along Magpie Creek, located in the northeast corner of the Industrial Wastewater Treatment Plant (IWTP). The skimming basin was built in 1944 to remove oil from water in the creek (CH2M HILL, 1993). The basin is concrete-lined, and approximately 115 feet long by 50 feet wide. Water from Magpie Creek is diverted by means of a diversion dam into the skimming basin; all of the water flowing in Magpie Creek passes through the skimming basin. In 1943 and 1944, about 500 gallons of oil a day were reportedly removed from the creek. The oil was either sold or piped to the burning pit (Confirmed Site [CS] 22, in OU C1) by means of a 2-inch pipe. The location of the pipe is not known.

In 1957, a ditch was constructed to connect Don Julio Creek to the skimming basin at PRL 28; however, today a sluice dam north of PRL 28 prevents the creeks from joining. Oil from the basin is now collected in a large aboveground storage tank, then sent to the oil/water separator at the IWTP.

Water from PRL 28 is typically discharged to PRL 60, the oxidation ponds immediately west of Patrol Road. (The flow can bypass the ponds, if desired.) The ponds were built in 1957 to help control releases of contaminated water in Magpie Creek by providing additional retention and/or dilution of the water (CH2M HILL, 1993). The ponds are unlined, about 1,000 feet long, 50 feet wide, and 6 feet deep. Each pond was designed to hold about 4.5 million gallons of water. Water is pumped from the skimming basin to the eastern pond, where it is aerated by means of three aeration pipes visible on historical aerial photographs. From the eastern pond, water is pumped to the western pond at its southern end to another aeration pipe (CH2M HILL, 1993; page 6.10-7); from this pond, water is pumped back into Magpie Creek. In the past, the ponds may have been used to store IWTP influent during periods of high flow. Currently, the ponds act as a flow-through system for water in Magpie Creek. Both ponds are stocked with fish and always contain water.

Potential Release Location P-10 is the portion of the Magpie Creek channel currently underneath Building 783. The location was identified in 1989 because analysis of soil samples, collected in and around Magpie Creek when Building 783 was extended, indicated six volatile organic compounds (VOCs) were present in the soil (Table 5.7-1). Nine metals were also detected above background concentrations. Exact sampling locations are unknown; however, all were probably in the area now beneath Building 783.

Investigation Cluster 15 also includes Magpie Creek from the point where it enters the IC to the point where it crosses beneath Lang Avenue, west of Building 786. Between 1943 and 1945, the Magpie Creek channel was altered and lined with concrete, at least as far as PRL 28. The bottom of the creekbed is lined with corrugated steel; it is uncertain when the steel was added. Downstream of PRL 28, the creek channel was also altered (to the channel that includes PRL P-10); this

portion was unlined. In 1988, when an extension was added to Building 783, the creek channel downstream of PRL 28 was altered again, to its present course. This channel is also unlined.

Magpie Creek receives stormwater runoff from across McClellan AFB. In the 1940s, the creek received all of the industrial wastewater from the industrial areas on the east side of McClellan AFB (CH2M HILL, 1993). Wastes discharged to the creek included fuels, oils, solvents, phenol, cyanide, chromic acid, cresol, and sodium hypochlorite. In 1946, the skimming basin (PRL 28) was built to remove oils and floating materials from the creek; however, it could not remove or neutralize the chemicals responsible for odor and taste problems reported by downstream neighbors. In the 1950s, four IWTPs were built in other areas of McClellan AFB to treat plating shop and desealant operation wastes; all four IWTPs discharged their treated effluent to Magpie Creek.

In 1974, the current IWTP was built in what is now IC 14. It replaced the other four IWTPs. From 1974 until discharge was halted in 1984 or 1985, all IWTP effluent was discharged to the creek. Effluent was then discharged to the Sacramento Regional County Sanitation District until 1987 (MacDonald, 1993). In 1987, the IWTP was connected to the Regional Sanitary Sewer Intercept line; all effluent is now discharged to the intercept. In 1982, a power failure at the IWTP resulted in discharge of about 192,000 gallons of IWTP influent to Magpie Creek over an 8-hour period.

Previous investigations of IC 15 are summarized in Table 5.7-1.

5.7.1 Data Quality Objectives

The data quality objectives for this stage of the Remedial Investigation (RI) at IC 15 are shown on Table 5.7-2.

5.7.2 Sampling Plan

Proposed sampling locations are shown on Figure 5.7-2; previous sampling locations are shown on Overlay A. Potential contaminants of concern and the sampling and analytical matrix for IC 15 is shown on Table 5.7-3; field specifications for sampling locations are included on Table 5.7-4.

Rationale and specific objectives for sampling locations are outlined below.

Boring SB3 will be drilled to groundwater and converted to a monitoring well as recommended in the Draft Groundwater OU RI/FS. Groundwater contaminant concentrations and flow directions are not defined in this area.

At PRL 28, one composite sediment sample (MC1) will be collected within the skimming basin to determine whether sediment in the basin contains contaminants. Contaminants of concern (COCs) in the oil skimming basin include semivolatile organic compounds, inorganic species, polychlorinated biphenyls (PCBs), radionuclides, petroleum hydrocarbons, polycyclic aromatic hydrocarbons, and dioxins/furans. These compounds, excluding radionuclides, may have been in oil skimmed in the basin. Radionuclides are a COC from an upstream location and may have migrated downstream to PRL S-28. Samples will also be analyzed for Chrome VI and cyanide since these compounds were reported in previous investigations at the location. Sufficient borings have been drilled

as part of the OU C1 investigation to characterize subsurface contamination beneath the basin (results are not yet available).

At PRL 60, soil gas samples will be collected from dry wells (Monitoring Well [MW] 77 through MW-80, and MW-21S) (now screened in the vadose zone) to determine whether the deep soil gas beneath PRL 60 is contaminated with VOCs. These samples may also help define the extent of the contaminant smear zone originating in OU C1.

Sediment samples ML1 through ML8 will be collected from the bottom of the oxidation ponds to determine whether the sediments are contaminated. Samples will be analyzed for radionuclides, PCBs, and cyanide (in addition to the standard suite of COCs in Table 4-11 in Section 4.3.2) since upstream locations (PRL 32 and PRL 28) may have discharged these COCs to the creek.

Because the oxidation ponds are unlined, they may be leaking and providing a hydraulic driving force for vertical contaminant migration. Borings SB1 and SB2 will be drilled at an angle beneath the oxidation ponds in PRL 60 to determine whether the ponds are leaking and thereby providing a hydraulic driving force for contaminant migration. Samples will be collected for bulk density analysis, which includes a percent moisture calculation; results will show whether or not the soils are saturated. If the soils are dry, soil gas samples will be collected to determine whether the soil gas is contaminated.

Sediment samples MC2, MC3, and HA1 through HA4 are all located in Magpie Creek (PRL P-10). Where the creek is lined, scrape samples will be collected of the sediments within the lined channel (MC2 and MC3). Where the creek is unlined, hand auger samples will be collected from the surface of the creekbed to 5 feet below the creekbed to determine whether the sediments are contaminated and whether the contaminants have migrated to the subsurface. Samples will be collected for semivolatile organic compounds, inorganic species, petroleum hydrocarbons, and radionuclides.

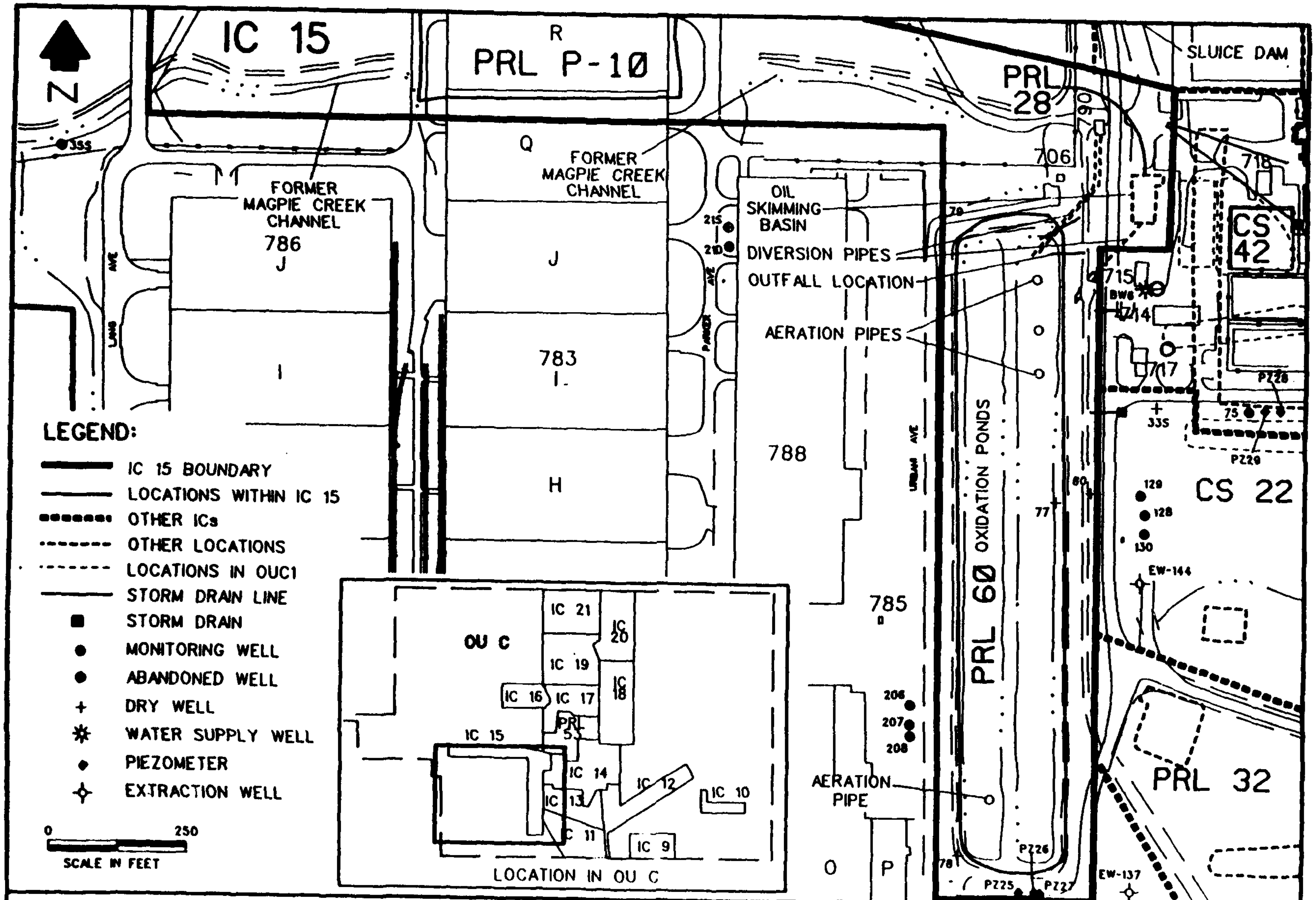


Figure 5.7-1 Potential Discharge Areas in IC 15

OUC4 IC15PDA SAC [illegible]

TABLE 5.7-1. PREVIOUS INVESTIGATIONS AT IC 15

Year, Contractor	Scope of Investigation	Key Findings
1953, McClellan AFB	Two water samples were collected from PRL 28; purpose of the sampling is not known.	Results indicate oil at 2 to 4 mg/L; copper, nickel, and cyanide < 0.5 mg/L; chrome VI up to 0.75 mg/L; and phenolic compounds < 0.010 mg/L.
1979 and 1980, McClellan AFB	Water samples were collected from PRL 60; purpose of the sampling is not known.	Eight VOCs were detected in pond water. Concentrations above MCLs included 1,1,1-TCA (524 µg/L) and 1,2-DCA (3.6 µg/L).
1985, McLaren Environmental Engineers	Investigation of potential contamination at PRL 28 and PRL 60. Seven borings were drilled; the four at PRL 60 were converted to piezometers. Borings at PRL 28 were outside the location, because of inaccessibility to a drill rig. Two samples from each boring analyzed for priority pollutant compounds (shallow samples) and VOCs (deeper samples). At least one groundwater sample was collected from each piezometer; results are available for only one sampling event.	PRL 28: oil and grease (0.140 mg/kg at 59 feet BGS) were detected in one boring; low concentrations (<25 µg/kg) of toluene was reported in two borings at 60 feet BGS. Source of contamination may be OU C1. PRL 60: no contaminants were detected in the soil samples. Groundwater samples contained 5 different VOCs; MW-80 contained TCE at 6,300 µg/L and trans-1,2-DCE at 100 µg/L.
1988, McClellan AFB	Investigation of Magpie Creek sediments and surrounding soil prior to construction of the Building 783 addition. Exact sampling locations are unavailable.	Six VOCs and nine metals above background concentrations detected in soil. Metals included arsenic, cadmium, copper, silver, mercury, and thallium.
1989, Radian Corporation	Basewide investigation of surface soil vapor for potential organic contamination.	Maximum HNu® results were 7.2 ppmv; maximum OVA results were 1.3 ppmv.
1989, Radian Corporation	Basewide investigation of stream water and sediments for potential organic and metal contamination. Samples were analyzed for VOCs, SVOCs, oil and grease, cyanide, and metals by ICP.	Sediment sample downstream from PRL 28 contained 500 mg/kg TPH, low levels (< 15 µg/kg) of 2 VOCs, and 10 SVOCs, including 1200 µg/kg pyrene, 1100 µg/kg fluoranthene, 240 µg/kg[a] phenol, and 680 µg/kg[a] benzo(a)pyrene. Samples 250 feet downstream contained phenol at < 250 µg/kg[a] at 1 and 2 feet BGS. Where Magpie Creek leaves base property, sediment contained 210 mg/kg TPH (< 1 foot BGS), and dichlorofluoromethane in the 1- and 2-foot samples. Cadmium and lead were reported above subsurface background at three locations in OU C. No contaminants were detected in water samples from PRL 60.

TABLE 5.7-1. (Continued)

Year, Contractor	Scope of Investigation	Key Findings
1990, Radian Corporation	Preliminary Groundwater Operable Unit Remedial Investigation. Installed six piezometers, and three monitoring wells in IC 15 to determine groundwater flow directions and other hydraulic parameters, and to determine effectiveness of the OU C extraction system.	Determined that extraction system is only partially capturing contaminated groundwater beneath OU C.
1992, Radian Corporation	Samples collected from Magpie Creek downstream of McClellan AFB as part of OU B RI to determine whether contaminants had migrated off base. Samples were analyzed for VOCs, SVOCs, inorganic species, and radionuclides.	Low levels (<300 ppm) petroleum hydrocarbons from five sample locations. Toluene (estimated at 160 $\mu g/kg$) and TCE (2.1 $\mu g/kg$) reported in two soil samples. Cadmium, chromium, mercury, silver, and zinc were reported above subsurface background concentrations in more than half the samples. Beta radioactivity was reported above subsurface background in less than half the samples.
1993, Radian Corporation	OU B1 RI/FS. Sediment samples were collected in the ditches draining OU B1 and from Magpie Creek. Samples were analyzed for SVOCs, inorganic species, and radionuclides.	Cadmium (3.6 mg/kg) was reported above sediment background concentrations in a sample from base boundary.
1993, CH2M HILL	Preliminary Assessment of sites and locations in OU C.	Identified areas to be investigated in OU C through records review, site visits, and interviews with base personnel.
Ongoing, McClellan AFB	Monthly sampling of water in Magpie Creek, in compliance with NPDES permit.	No major violations reported.
Ongoing, Radian Corporation	Groundwater Sampling and Analysis Program to determine groundwater contaminant concentrations	Concentrations of TCE, cis-1,2-DCE, and 1,1-DCA have been consistently reported in samples from MW-206, about 20 feet east of PRL 60. A plume of contaminated groundwater flowing past IC 15 has also been identified; it apparently originates in OU C1.

[a] Estimated concentrations; less than 5 times the detection limit.

NOTE: Acronyms are defined in the acronym list at the beginning of this SAP.

TABLE 5.7-2. DATA QUALITY OBJECTIVES FOR PRL 28

Problem Statement

Contaminants in Magpie Creek could have contaminated sediments in the skimming basin.

Decision to be Made

- Determine if sediments in PRL 28 contain contaminants.
- Determine the location priority.

Inputs to the Decision

Level III data for sediments.

Boundaries of the Study

Sediment samples from within the skimming basin.

Decision Rule

- If organic compounds are reported in sediment samples, then sediments are contaminated.
- If inorganic species are reported above background concentrations in sediment samples, then sediments or soils may be contaminated and the decision process for inorganic species should be applied.
- If all data collected are validated, proceed to Data Evaluation DQOs (see Section 4.2.2).

Limits on Uncertainty

Analytical data must meet project specifications for precision and accuracy.

Sample Design

Composite sediment sample MC1 will be a 5:1 composite of basin sediments.

(Continued)

TABLE 5.7-2. (Continued)

DATA QUALITY OBJECTIVES FOR PRL 60

Problem Statement Contaminants in the water may have contaminated the sediments and subsurface beneath PRL 60. The unlined ponds of PRL 60 may provide a hydraulic driving force for vertical contaminant migration.
Decision to be Made • Determine if contaminants in the water have contaminated the sediments. • Determine if contaminants have migrated to the subsurface. • Determine if water leaking from the ponds is providing a driving force for contaminants at other sites to migrate vertically. • Determine the location priority.
Inputs to the Decision Level II/III for VOCs in soil gas; Level III for organic compounds and inorganic species in soil; Level III for bulk density samples.
Boundaries of the Study Soil gas samples will be collected from the four dry piezometers surrounding PRL 60, and from 20 to 80 feet BGS beneath PRL 60. Sediment samples will be collected from the bottom of the ponds. Physical parameters will be collected from 20 to 80 feet BGS.
Decision Rule • If organic compounds are reported in sediment samples, then sediments are contaminated. • If inorganic species above background concentrations are reported in sediment or soil samples, then sediments or subsurface soil may be contaminated and the decision process for inorganic species should be applied. • If VOCs are reported in the soil gas and if concentrations are greater than adjacent or surrounding borings, the contamination may have originated at this location. • If vadose zone soils are wet or saturated from the ponds are providing a driving force for vertical contaminant migration. • If all data collected are validated, proceed to the Data Evaluation DQOs (see Section 4.2.2).
Limits on Uncertainty Analytical data must meet project specifications for precision and accuracy.
Sample Design Sediment samples ML1 – ML8 will be placed near and between the aeration pipes and at regularly spaced intervals in the oxidation ponds to determine if sediments are contaminated. Borings SB1 and SB2 will be angle borings drilled beneath the ponds to determine the vertical extent of contamination and if the ponds are a hydraulic driving force to groundwater.

(Continued)

TABLE 5.7-2. (Continued)

DATA QUALITY OBJECTIVES FOR SOIL AND SOIL GAS AT PRL P-10

Problem Statement

Contaminants carried in Magpie Creek could have contaminated the subsurface.

Decision to be Made

- Determine if sediments in Magpie Creek contain contaminants.
- Determine if any contaminants have migrated to the subsurface.
- Determine the location priority.
- Determine if soil gas is contaminated and the extent of the smear zone for OU C1.

Inputs to the Decision

Level II/III data for soil gas; Level III data for sediments and subsurface soil.

Boundaries of the Study

Soil gas samples from 20 to 100 feet BGS; sediment samples from the surface of the creekbed to 5 feet below the creekbed.

Decision Rule

- If VOCs are reported in soil gas and if concentrations decrease with depth, then the soil gas contamination may originate at this location.
- If VOC concentrations are low or not detected in the shallow soil gas (<40 feet BGS), but are reported or increase with depth in the deep soil gas (>40 feet BGS), the soil gas contamination is probably from the smear zone left by declining water levels.
- If organic compounds are reported in sediments samples, then sediments are contaminated.
- If inorganic species above background concentrations are reported in sediment or soil samples, then sediments or subsurface soil may be contaminated and the decision process for inorganic species should be applied.
- If organic compounds from the location are reported in soil samples, then Magpie Creek has contaminated the subsurface soil.
- If all data collected are validated, proceed to the Data Evaluation DQOs (see Section 4.2.2).

Limits on Uncertainty

Analytical data must meet project specifications for precision and accuracy.

Sample Design

Composite surface scrapes MC2 and MC3 will be placed at the outfall from PRL 60 and the diversion dam to PRL 28, respectively. Hand augers HA1–HA4 will be drilled within the creek. Samples will be placed at low spots, outfalls, and on the deposition bank of curves in the creek. Samples will not be placed in locations where previous investigations have already collected adequate data. Boring SB3 will be drilled adjacent to the creekbed and east of the area where VOCs were reported in soil during 1988.

TABLE 5.7-2. (Continued)

DATA QUALITY OBJECTIVES FOR GROUNDWATER BENEATH PRL P-10

Problem Statement

The western edge of the OU C1 plume has not been bounded.

Decision to be Made

- Determine if groundwater flow directions.
- Determine if the groundwater beneath PRL P-10 is contaminated.
- Determine location priority.

Inputs to the Decision

Level III data for groundwater. Previous groundwater flow and contaminant data.

Boundaries of the Study

Groundwater samples from the A monitoring zone.

Decision Rule

- Contaminants from the location have contaminated the groundwater if all of the following are true:
  - Organic compounds above background are reported in groundwater samples downgradient of the location.
  - Those suites of compounds are alsc reported in soil gas beneath the location, and
  - Those compounds are not reported or are reported at lower concentrations in upgradient samples.
- If all data collected are validated, proceed to Data Evaluation DQOs (see Section 4.2.2).

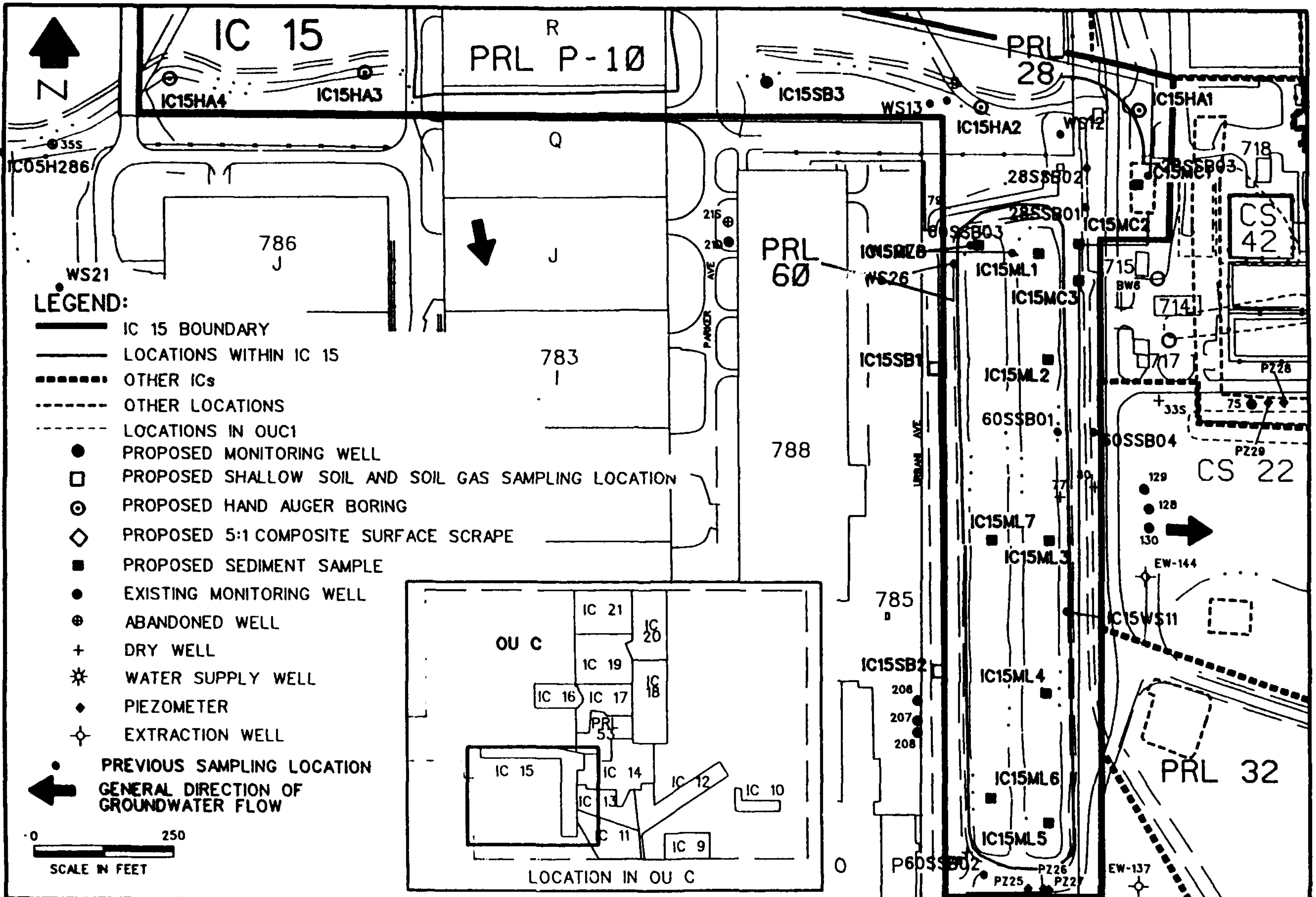
Limits on Uncertainty

Analytical data must meet project specifications for precision and accuracy.

Sample Design

Boring SB3 will be drilled to groundwater and sampled. It will be converted to a groundwater monitoring well and sampled after it is installed and developed.

NOTE: All acronyms are defined in the acronym list at the beginning of the SAP.



Overlay A. Previous Sampling Locations

Figure 5.7-2 Proposed Sampling Locations in IC 15

OUC4 IC15PSL SAC 2/28/94

TABLE 5.7-3. SAMPLING AND ANALYSIS MATRIX FOR IC 15

Location:	PRL 28	PRL 60		
Potential Contaminants of Concern	SVOCs, Inorganic species (including Chrome VI), PCBs, Radionuclides, TPH, PAHs, Dioxins/furans, Cyanide	VOCs, SVOCs, Inorganic species, PCBs, Radionuclides, TPH, Cyanide		
Sampling Location:	Sediment Sample MC1	Borings SB1[a,h]-SB2[a,h]	Sediment Samples ML1-ML8	Existing Well MW-77 (dry)
Sample Depth and Analytical Method:	(0-0.25') ModSW8015/3550, SW8080, SW6010, SW8280, SW8270, SW9012, E901.1, SW9310, SW9045, SW7471, SW7740, E218.6, SW8310, SW7060	(30') FGC ASTM 2937 (60') FGC ASTM 2937 (85') FGC ASTM 2937 (110') FGC ASTM 2937	(0-0.25') ModSW8015/3550, SW6010, SW8270, SW8080, E901.1, SW9012	(93.5-98.5') FGC

(Continued)

TABLE 5.7-3. (Continued)

Location:	PRL 60 (continued)				PRL P-10		
Potential Contaminants of Concern:					VOCs, SVOCs, Inorganic species, Radionuclides, TPH		
Sampling Location:	Existing Well MW-78 (dry)	Existing Well MW-79 (dry)	Existing Well MW-80 (dry)	Existing Well MW-21S (dry)	Boring SB3	Sediment Samples MC2, MC3	Sediment Samples HA1[c]-HA4[c]
Sample Depth and Analytical Method:	(89.7-99.7') FGC	(92-102') FGC	(85-95') FGC	(78-88') FGC	(15-25') FGC (35-45') FGC (55-65') FGC (75-85') FGC (90-100') FGC (groundwater) SW8260[c,d]	(0-0.25') ModSW8015/3550, SW6010, E901.1, SW9310, (1') SW8270	(0-0.25') ModSW8015/3550, SW6010, SW9012, E901.1, SW9310, SW7471, SW7060, SW7740, (1') SW8270 (5') ModSW8015/3550, SW8270, SW6010, SW7471, SW7060, SW7740, SW9012

(Footnotes are presented on following page.)

TABLE 5.7-3. (Continued)

[a] Borings will be drilled at a 45° angle. Depths are borehole depths. Samples will be collected at approximately 20, 40, 60, and 80 feet BGS (vertically), respectively. If soils are wet, FGC samples will not be collected.
[b] Four samples will be collected in each boring (SB1 and SB2) for bulk density analysis (ASTM 2937) in different soil types.
[c] for SW8240 analytes.
[d] The benefits and limitations of Method SW8260 are currently being compared with Methods SW8010 and SW8020. Depending on the outcome of this review, Methods SW8010 and SW8020 may be used instead of SW8260.
[e] 5:1 composite samples

FGC = Screening analysis of soil gas for commonly detected VOCs with on-site chromatograph.

NOTE: Matrix represents the minimum number of samples to be collected in each horizon.
FGC analyses will be confirmed with 10% TO-14 analysis.
Specific sample depths will be determined in the field using the sampling criteria specified in Section 4.
All acronyms are defined on the acronym list at the beginning of the SAP.

TABLE 5.7-4. SAMPLING AND FIELD SPECIFICATIONS FOR IC 15

Boring/Location Name	Reference Point	Distance	Maximum Depth Interval (ft BGS)
Sediment Samples			
ML1	MW-77	429'N, 38'W	0.25
ML2	MW-77	244'N, 20'W	0.25
ML3	MW-77	78'S, 21'W	0.25
ML4	MW-77	348'S, 27'W	0.25
ML5	MW-77	577'S, 21'W	0.25
ML6	MW-78	95'N, 43'E	0.25
ML7	MW-78	555'N, 46'E	0.25
ML8	MW-77	64'S, 60'W	0.25
MC1	Northeast inner corner of PRL S-28	13'S, 32'W	0.25
MC2	MW-80	420'N, 25'W	1
MC3	MW-80	347'N, 15'W	1
Hand Augers			
HA1	Northwest corner of Bldg. PRL S-28	94'N, 11'E	5
HA2	Northwest corner of Bldg. PRL S-28	97'N, 272'W	5
HA3	MW-35S	133'N, 557'E	5
HA4	MW-35S	120'N, 209'E	5
Borings			
SB1	Southeast corner of Bldg. 788	399'N, 131'E	110[a]
SB2	Southeast corner of Bldg. 788	124'S, 140'E	110[a]
SB3	Northwest corner of Bldg. 788	158'N, 51'E	100

[a] Boring depth.

5.8 Field Sampling Plan for Investigation Cluster (IC) 16 (Potential Release Location [PRL] 50, PRL 51, and portions of Don Julio Creek)

Investigation Cluster 16 comprises PRLs 50 and 51 and the portion of Don Julio Creek from PRL 50 to the McClellan Air Force Base (AFB) boundary (Figure 5.8-1). The IC is located on either side of Patrol Road in the central portion of Operable Unit (OU) C. Monitoring Wells (MWs) 81 and 82 are located within PRL 51; both wells are 2-inch piezometers and are currently dry.

Potential Release Location 50, a former settling pond next to Don Julio Creek, appears on aerial photographs taken from 1956 through 1958; by 1959, it was filled in with soil (CH2M HILL, 1993). The pond may have been used for creek water; however, this is not certain. Today, the location is a dirt turnout on Patrol Road. An oil skimming system was installed in the creek along the edge of the turnout about 1970, and currently operates when creek flow is low. Creek water is diverted into the oil/water separator by means of a 1-foot diversion dam (Figure 5.8-1). Oil collected at the separator is removed by tanker truck and transported to the Industrial Wastewater Treatment Plant (IWTP). The boundaries of PRL 50 have been expanded in this Sampling and Analysis Plan (SAP) to include the oil/water separator.

Potential Release Location 51 comprises two raised water holding ponds constructed in 1980; both are surrounded by levees. They were built for a reclamation project that used treated effluent from the IWTP for irrigation (CH2M HILL, 1993); the project was stopped in 1985. During high flow periods (rainfall events) from 1985 to 1989, the ponds held treated IWTP effluent before it was discharged to Magpie Creek. The effluent was reportedly pumped to the smaller pond. When that pond was full, the water was pumped into the larger pond (Gregory, 1989). The location of the piping from the IWTP is not known. Since 1989, the ponds have held rainwater and may be used by the IWTP for effluent storage during peak water periods. The larger, western pond is earthen lined and has vegetation growing on its banks; the smaller, eastern pond is lined with cement. Capacity of the two is reported to be ten million gallons (Gregory, 1989). Depths of the ponds are estimated to be about 11 feet.

Investigation Cluster 16 includes the portion of Don Julio Creek surrounding PRL 50 and the rest of the creek downstream to the point where it exits McClellan AFB. The creekbed is lined with cement surrounding PRL 50 and to the north fence at PRL 51; beyond the fence, the creek is unlined. The ditch connecting Don Julio Creek with Magpie Creek (to the south) was constructed in 1957; when the ditch was lined is unknown. A portion of the creek was realigned west of PRL 51 in approximately 1988 as part of a habitat restoration project.

Previous investigations of IC 16 are summarized in Table 5.8-1.

5.8.1 Data Quality Objectives

Data quality objectives for IC 16 are shown on Table 5.8-2.

5.8.2 Sampling Plan

Proposed sampling locations are shown on Figures 5.8-2 and 5.8-3. Previous sampling locations are shown on Overlay A. Potential contaminants of concern and sampling and analytical matrix for IC 16 is

shown in Table 5.8-3; field specifications for sampling locations are included in Table 5.8-4.

Rationale and specific objectives for sampling locations are outlined below.

Boring SB3 will be drilled to groundwater and converted to a monitoring well to help determine contaminant concentrations and groundwater flow directions in support of the Groundwater OU RI/FS.

Deep soil gas samples will be collected from the screened intervals of MW-81 and MW-82 and analyzed to determine whether volatile organic compounds (VOCs) are present in the deep soil gas. Both wells are located on the levees surrounding the ponds at PRL 51, are screened at approximately 85-95 feet below ground surface (BGS), and are currently dry.

Borings SB1, SB2, and SB4 will be drilled in the levees of PRL 51 to 40 feet below grade and sampled for soil gas contamination. The purpose of the borings is to determine if any VOC contamination from PRL 51 has migrated into the subsurface.

Boring SB5 will be drilled to 40 feet BGS through PRL 50 to determine whether the contents of the former settling pond have contaminated the environment. Soil samples will be collected at 5 and 10 feet BGS. Soil gas samples will be collected from about 20 to 40 feet BGS.

Sediment samples will be collected from the holding ponds at PRL 51. Eight sediment samples (ML1-ML8) will be collected from the bottom of the ponds to determine if IWTP effluent held in the ponds contaminated the sediments. Contaminants of concern include semivolatile organic compounds, polychlorinated biphenyls, inorganic species, petroleum hydrocarbons, and cyanide.

Six hand augers (HA1-HA6) will be drilled in the creek, in areas where sediments have accumulated: behind the diversion dam by the oil/water separator inlet; at the right-angle bend southwest of PRL 50, where semivolatiles were previously detected; at the confluence of Don Julio Creek and a tributary near the base boundary; and at the base boundary. The surface scrape samples at HA1 and HA2 (where the creek is lined) will be 5:1 composite samples of creek sediments.

Physical parameter samples will be collected from different soil types in the Boring SB3 to provide information for vadose zone modeling and for evaluation of remedial alternatives.

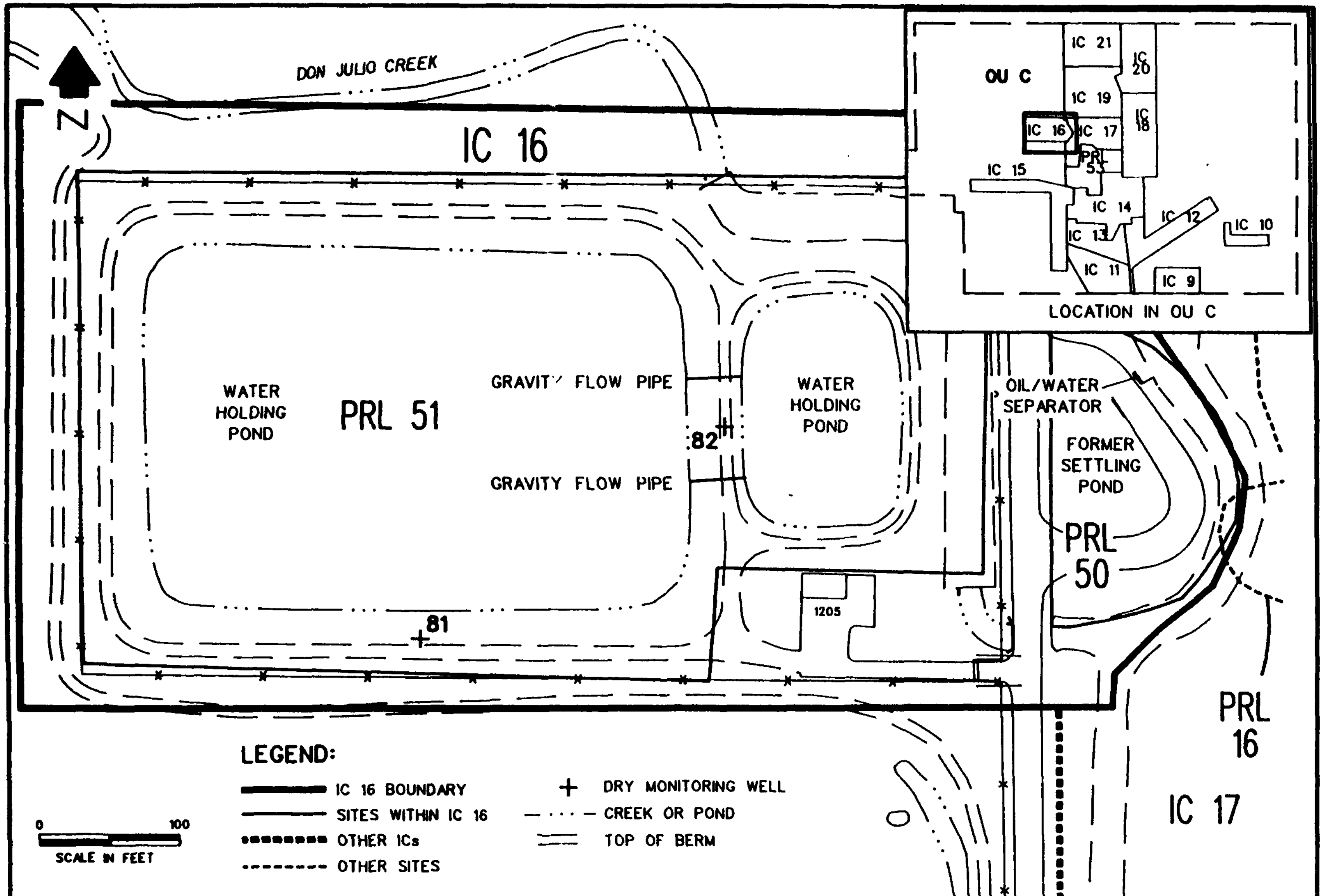


Figure 5.8-1 Potential Discharge Areas at IC 16

OUC4 IC16PDA SAC 2/24/94

TABLE 5.8-1. PREVIOUS INVESTIGATIONS AT IC 16

Year, Contractor	Scope of Investigation	Key Findings
1977, McClellan AFB	Sample collected for PCB analysis after PCBs were detected in IWTP effluent. Sample collected just south of PRL 50; exact location is not known.	PCBs were detected at 0.014 mg/kg.
1985, McLaren Environmental Engineers	Investigation of potential contamination at PRLs 50 and 51. At PRL 50, one waste sample boring drilled to 70 feet BGS. At PRL 51, two soil sample borings were drilled and converted to monitoring wells.	Samples were analyzed for volatiles, semivolatiles, pesticides, and metals. No priority pollutant compounds were detected. A grain size analysis was performed on one sample from each boring.
1986, McClellan AFB	Sediment and water samples collected along Don Julio Creek; purpose of investigation unknown.	Sediment sample collected from creekbed between PRLs 50 and 51 contained SVOCs, including benzo(a)pyrene at 451 $\mu g/kg$. Semivolatiles were at lower concentrations or not detected in samples collected downstream.
1989, Radian Corporation	Basewide investigation of stream water and sediments for potential organic and inorganic contamination.	Water samples were collected from both ponds at PRL 51; low concentrations of total and dissolved metals were detected. No background concentrations for metals in surface water have been established for comparison; however, results were at least two orders of magnitude below STLCs. Water samples collected from Don Julio Creek contained low levels of oil and grease and total petroleum hydrocarbons. Hand auger sediment samples collected from the surface to 3 feet deep near the holding ponds contained arsenic above subsurface background levels, oil and grease, TPH, and cyanide.
1989, Radian Corporation	Surface soil gas investigation	At PRL 50, maximum OVA and HNu® readings at the soil surface were 1.1 and 0.4 ppmv, respectively. At PRL 51, maximum readings were 4.0 and 17 ppmv, respectively.

NOTE: All acronyms are defined in the acronym list at the beginning of the SAP.

TABLE 5.8-2. DATA QUALITY OBJECTIVES FOR PRL 50

Problem Statement Compounds in the settling pond may have contaminated the sediments and subsurface beneath PRL 50.
Decision to be Made • Determine if contaminants in the water have contaminated the subsurface. • Determine the location priority.
Inputs to the Decision Level II/III data for VOCs in soil gas; Level III data for organic compounds and inorganic species in soil.
Boundaries of the Study Soil gas samples will be collected from 20 to about 40 feet BGS. Soil samples will be collected from 5 to 10 feet BGS.
Decision Rule • If organic compounds are reported in soil samples, then the soil has been contaminated. • If inorganic species above subsurface background concentrations are reported, then the soil may be contaminated and the decision process for inorganic species should be applied. • If VOCs are reported in the soil gas and if concentrations are greater than adjacent or surrounding borings, the contamination may have originated at this location. • If all data collected are validated, proceed to the Data Evaluation DQOs (see Section 4.2.2).
Limits on Uncertainty Analytical data must meet project specifications for precision and accuracy.
Sample Design Boring SB5 will be drilled in the middle of the former settling pond location.

(Continued)

TABLE 5.8-2. (Continued)

DATA QUALITY OBJECTIVES FOR SOIL AND SOIL GAS AT PRL 51

Problem Statement

Contaminants in the water may have contaminated the sediments and subsurface beneath PRL 51.

Decision to be Made

- Determine if contaminants in the water have contaminated the sediments.
- Determine if contaminants have migrated to the subsurface.
- Determine the location priority.

Inputs to the Decision

Level II/III for VOCs in soil gas; Level III for organic compounds and inorganic species in soil.

Boundaries of the Study

Soil gas samples will be collected from the two dry piezometers at PRL 51, and from 20 to about 100 feet below grade (i.e., 30 to 110 feet below the levees). Sediment samples will be collected from the bottom of the ponds.

Decision Rule

- If organic compounds are reported in sediment samples, then pond sediments are contaminated.
- If inorganic species above background concentrations are reported in sediment samples, then the sediment may be contaminated, and the decision process for inorganic species should be applied.
- If VOCs are reported in the soil gas and if concentrations are greater than those in adjacent or surrounding borings, the contamination has originated at this location.
- If VOCs are reported in soil gas and if concentrations decline with depth, then the contamination may originate at this location.
- If VOC concentrations are low or not detected in the shallow soil gas (<40 feet BGS), but are reported or increase with depth in the deep soil gas (>40 feet BGS), the contamination is probably from the smear zone left by declining water levels.
- If all data collected are validated, proceed to the Data Evaluation DQOs (see Section 4.2.2).

Limits on Uncertainty

Analytical data must meet project specifications for precision and accuracy.

Sample Design

Borings SB1-SB4 will be drilled along the outer levees of PRL 51. Boring SB1 is located in the area where elevated surface soil gas concentrations were reported. Soil gas samples will be collected from the bottom of dry wells MW-81 and MW-82. Sediment samples MC1-MC8 will be collected in the pond sediments at regularly spaced locations.

(Continued)

TABLE 5.8-2. (Continued)

DQOs FOR GROUNDWATER BENEATH PRL 51

Problem Statement

Date on groundwater flow directories and contaminant migration in western OUC are sparse.

Decision to be Made

- Determine groundwater flow directions.
- Determine if the groundwater beneath PRL 51 is contaminated.
- Determine location priority.

Inputs to the Decision

Level III data for groundwater. Previous groundwater flow and contaminant data.

Boundaries of the Study

Groundwater samples from the A monitoring zone.

Decision Rule

- Contaminants from the location have contaminated the groundwater if all of the following are true:
  - — Organic compounds or inorganic species above background are reported in groundwater samples downgradient of the location,
  - — Those suites of compounds or species are also reported in soil gas or soil beneath the location, and
  - — Those compounds or species are not reported at lower concentrations in upgradient samples.
- If all data collected are validated, proceed to Data Evaluation DQOs (see Section 4.2.2).

Limits on Uncertainty

Analytical data must meet project specifications for precision and accuracy.

Sample Design

Boring SB3 will be drilled to groundwater and sampled. It will be converted to a groundwater monitoring well and sampled after installation and development.

TABLE 5.8-2. (Continued)

DATA QUALITY OBJECTIVES FOR DON JULIO CREEK

Problem Statement Contaminants carried in Don Julio Creek could have contaminated the sediments or migrated off base.
Decision to be Made • Determine if sediments in Don Julio Creek contain contaminants. • Determine the location priority.
Inputs to the Decision Level III data for soils.
Boundaries of the Study Sediment samples will be collected from the creekbed and 5 feet beneath the creekbed.
Decision Rule • If organic compounds are reported in sediment or soil samples, then sediments are contaminated. • If inorganic species above background concentrations are reported in sediment samples, then the sediments may be contaminated and the decision process for inorganic species should be applied. • If all data collected are validated, proceed to the Data Evaluation DQOs (see Section 4.2.2).
Limits on Uncertainty Analytical data must meet project specifications for precision and accuracy.
Sample Design Hand augers HA1–HA6 will be placed at low spots, the diversion dam, and on deposition bank of bends in the creek. Samples will not be placed in locations where previous investigations have already collected adequate data. Surface samples at HA1 and HA2 will be 5:1 composite samples.

NOTE: All acronyms are defined in the acronym list at the beginning of the SAP.

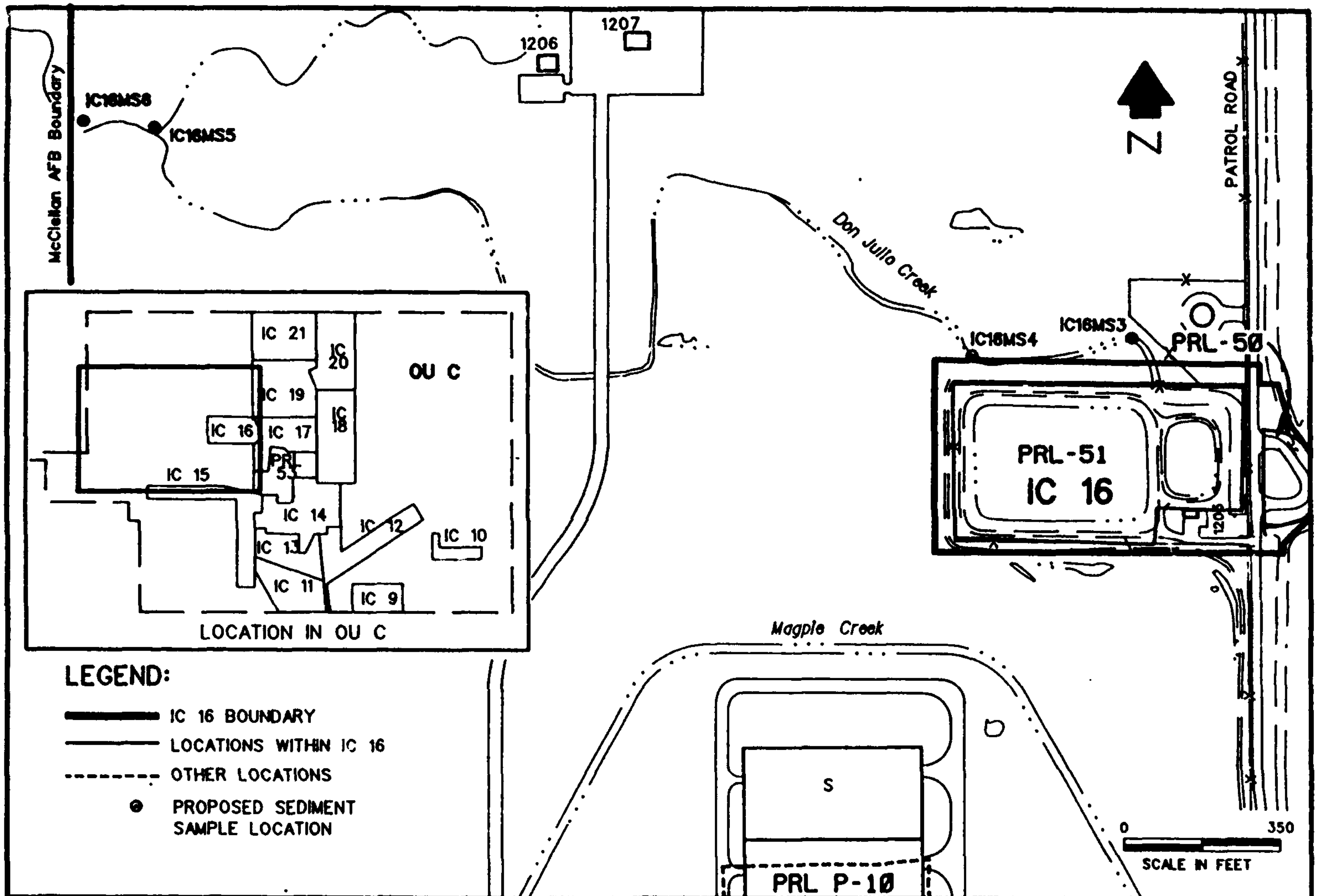


Figure 5.8-2 Proposed Sampling Locations at Don Julio Creek in IC 16

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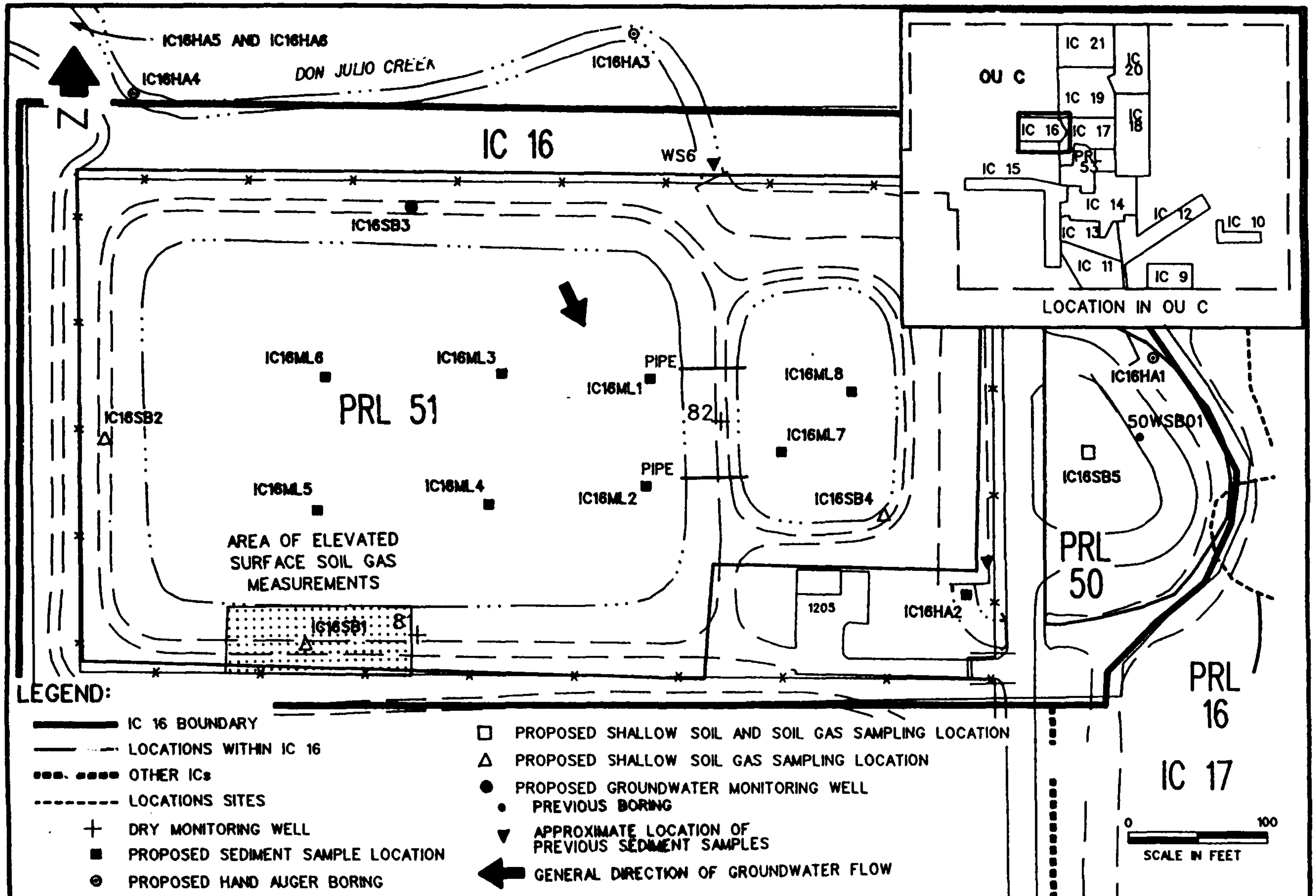


Overlay A. Previous Sampling Locations

Figure 5.8-3 Proposed Sampling Locations in IC 16

OUC4 IC16PSL SAC 2/23/94

TABLE 5.8-3. SAMPLING AND ANALYSIS MATRIX FOR IC 16

Location:	PRL 50	PRL 51				Don Julio Creek
Potential Contaminants of Concern:	Unknown	VOCs, SVOCs, PCBs, Inorganic species, Petroleum hydrocarbons, cyanide				SVOCs, Inorganic species, Petroleum hydrocarbons
Sampling Location:	Boring SB5	Borings SB1[a], SB2[a], SB4[a]	Borings SB3[c,d]	Sediment Samples ML1-ML8	Existing Wells MW-81, MW-82	Sediment Samples HA1[b], HA2[a]-HA6[a]
Sample Depth and Analytical Method:	(5') SW8270, ModSW8015/3550 ModSW8015/5030 SW6010	(25-35') FGC	(25-35') FGC	(0-0.25') ModSW8015/3550, SW6010, SW9012, SW8080, SW8270	(85-95') FGC	(0-0.25') ModSW8015/3550, SW6010,
		(45-55') FGC	(45-55') FGC			
	(10') SW8270, ModSW8015/3550 ModSW8015/5030 SW6010		(65-75') FGC			(1') SW8270
	(15-25') FGC		(85-95') FGC			(5') ModSW8015/3550, SW8270, SW6010
	(35-45') FGC		(100-110') FGC			
			(groundwater) SW8260[e,f]			

(Footnotes presented on following page.)

TABLE 5.8-3. (Continued)

[a] Depths (in parentheses) selected to sample soil gas at consistent depth intervals as specified in Section 4.4. Boring will be drilled on berms surrounding the ponds (area is elevated above surrounding topography).
[b] 5:1 composite sample.
[c] Samples in creeks will be collected from the deposition bank (inside corner).
[d] Three samples will be collected for bulk density analysis (ASTM 2937) in different soil types.
[e] For SW8240 analytes.
[f] The benefits and limitations of Method SW8260 are currently being compared with Methods SW8010 and SW8020. Depending on the outcome of this review, Methods SW8010 and SW8020 may be used instead of SW8260.

FGC = Screening analysis of soil gas for commonly detected VOCs with on-site chromatograph.

NOTE: Matrix represents the minimum number of samples to be collected in each horizon.
FGC analyses will be confirmed with 10% TO-14 analysis.
Specific sample depths will be determined in the field using the sampling criteria specified in Section 4.
All acronyms are defined on the acronym list at the beginning of the SAP.

TABLE 5.8-4. SAMPLING AND FIELD SPECIFICATIONS FOR IC 16

Boring/Location Name	Reference Point	Distance	Maximum Depth Interval (ft BGS)
Borings			
SB1	MW-81	6'N, 79'W	55
SB2	MW-81	139'N, 232'W	55
SB3	MW-82	151'N, 222'W	100
SB4	MW-82	65'S, 118'E	55
SB5	Oil/water separator	60'S, 37'W	45
Hand Augers			
HA1	Oil/water separator	7'N, 10'E	5
HA2	Southeast corner of Bldg. 1205	0'N, 90'E	5
HA3	Northeast corner of fence	109'N, 257'W	5
HA4	Northwest corner of fence	61'N, 39'E	5
HA5	Intersection of Creek w/Base boundary	16'N, 187'E	5
HA6	Intersection of Creek w/Base boundary	26'N, 26'E	5
Sediment Samples			
ML1	MW-82	29'N, 50'W	0.25
ML2	MW-82	45'S, 55'W	0.25
ML3	MW-82	34'N, 157'W	0.25
ML4	MW-82	58'S, 166'W	0.25
ML5	MW-82	61'S, 290'W	0.25
ML6	MW-82	30'N, 284'W	0.25
ML7	MW-82	21'S, 43'E	0.25
ML8	MW-82	21'N, 94'E	0.25

5.9 Field Sampling Plan for Investigation Cluster (IC) 17 (Confirmed Sites (CSs) 43, 52, 67, and Potential Release Locations [PRLs] 15 and 16)

Investigation Cluster 17 comprises CSs 43, 52, and 67, and PRL 15 and 16 (Figure 5.9-1). The IC is located in the central portion of Operable Unit (OU) C.

Confirmed Site 43 is an inactive unlined waste disposal trench that was approximately 405 feet long, 50 feet wide, and 20 feet deep (CH2M Hill, 1993). Reports indicate that the trench received wastes from the mid-1940s to 1957. Wastes disposed in the trench include demolition debris, burned wood, metal debris, glass, and plastic. The trench was backfilled with soil sometime between 1959 and 1963.

Confirmed Site 52 is an inactive burial pit just south of CS 43. The pit was approximately 420 feet long by 50 feet wide and is visible on aerial photographs taken from 1956 to 1959. Wastes reportedly consisted of metals, burned material, and concrete. In 1959 the southern half of CS 52 was covered by a concrete mat. Since 1960, a dirt road (Shelter Road) has traversed the middle of CS 52.

Confirmed Site 67 is another inactive burial pit. The pit was approximately 240 feet long and 160 feet wide and may have been used between 1959 and 1963. Concrete, plastic film, metal debris, wood, burned material, paper, and asphalt have been found in the pit.

Potential Release Locations 15 and 16 are reportedly sodium valve disposal pits. The sodium valves were designed to deliver fuel to the ignition chamber in a piston (reciprocating) aircraft engine. These trenches were reported to be somewhere south of CSs 11, 12, and 13, but were not located during McLaren's 1985 investigation. One valve was recovered during the investigation of CS 67 in 1985. Surface disturbance was noticed south of CS 67, near where the valve was found, in aerial photographs taken after 1946. A 1956 photograph showed another disturbed area east of CS 43. These surface disturbances are thought to be PRLs 15 and 16.

Tank 702 was a 250-gallon diesel underground storage tank (UST) located near Building 702. The UST was installed in 1959 and removed in 1989. Information regarding potential contamination and remedial activities were unavailable.

Don Julio Creek flows through portions of IC 17. The creek receives runoff from OU D and the northern portion of OU C. The western section of the creek is lined with steel.

Previous investigations of IC 17 are summarized in Table 5.9-1.

5.9.1 Data Quality Objectives

The data quality objectives for this stage of the RI at IC 17 are shown on Table 5.9-2.

5.9.2 Sampling Plan

Proposed sampling locations are shown on Figure 5.9-2. Overlay A shows previous sampling locations, including those used to construct cross sections through the area. Three cross sections of IC 17 (shown on Figures 5.9-3, 5.9-4, and 5.9-5), were used to target lithologic layers for sample collection within each burial pit. Potential contaminants

of concern and the sampling and analytical matrix for IC 17 are shown in Table 5.9-3; field specifications for sampling locations are included in Table 5.9-4.

Rationale and specific objectives for sampling locations are outlined below.

Magnetometer and electromagnetic surveys will be conducted at each pit prior to drilling at the location. If objects which may be buried drums are identified (see Section 4.4), then proposed borings in the area will not be drilled and trenches will be dug to locate the anomaly and remove any buried drums. Soil samples will be collected as specified in Section 4.4. Standard operating procedures for digging trenches and removing drums are included in Appendix B to this report.

Three to four borings will be drilled through the approximate center of each pit (SB1 through SB4 in CS 43, SB5 through SB8 in CS 52, and SB9 through SB11 in CS67). Borings will be spaced about 100 feet apart. Samples will be collected from within the waste materials to characterize the heterogeneous nature of the wastes, and to determine whether contaminants in those wastes have migrated beneath the pits. Samples analyzed for organic compounds will be composited 4:1 over approximately 10-foot intervals in the pits to characterize the waste. (In CS52, where there may not be enough waste material to composite, discrete samples will be collected.) Beneath the pits, discrete samples will be collected from the native soil. The discrete sample yielding the highest concentration of inorganic constituents relative to the constituents toxicity will be analyzed for soluble metals (Section 4.3.2). Soil gas samples will be collected from within the pits and from the sandy layers beneath them.

Boring depths may vary depending on the bottom of the waste and the decisions made with the boring decision diagram (Section 4.4). Borings drilled through the waste material will be cased to at least 10 feet below the bottom of the pits.

Borings SB2 and SB14 (PRL 15) and SB 12 (PRL 16) will be drilled in the suspected locations of the sodium valve trenches at PRLs 15 and 16. In addition to the standard contaminants of concern (COCs) at suspected pits (see Table 4-11 in Section 4.3.2), soil from these PRLs will be analyzed for CS 43 and CS 67 COCs due to their close proximity to the known pits and the boundaries of those pits are not clearly defined.

Boring SB13 will be drilled and sampled just south of Building 702 in the approximate former location of Tank 702. The tank location will be confirmed through a record search of Civil Engineering construction diagrams. Samples will help determine whether the tank has leaked and contaminated the subsurface. Soil gas samples will also be collected to confirm no other contaminants besides diesel are present.

Four hand augers (HA1 through HA4) will be sampled at bends, confluences, and at locations where the seasonal creeks pass through IC 17. Surface samples collected at these locations will be composited 5:1. Results will indicate if sediments have been contaminated from activities within or upstream from IC 17.

Scrape sample MS1 will be collected in the lined ditch (Don Julio Creek) west of IC 17 to determine whether creek sediments are contaminated. The sample will be composited 5:1.

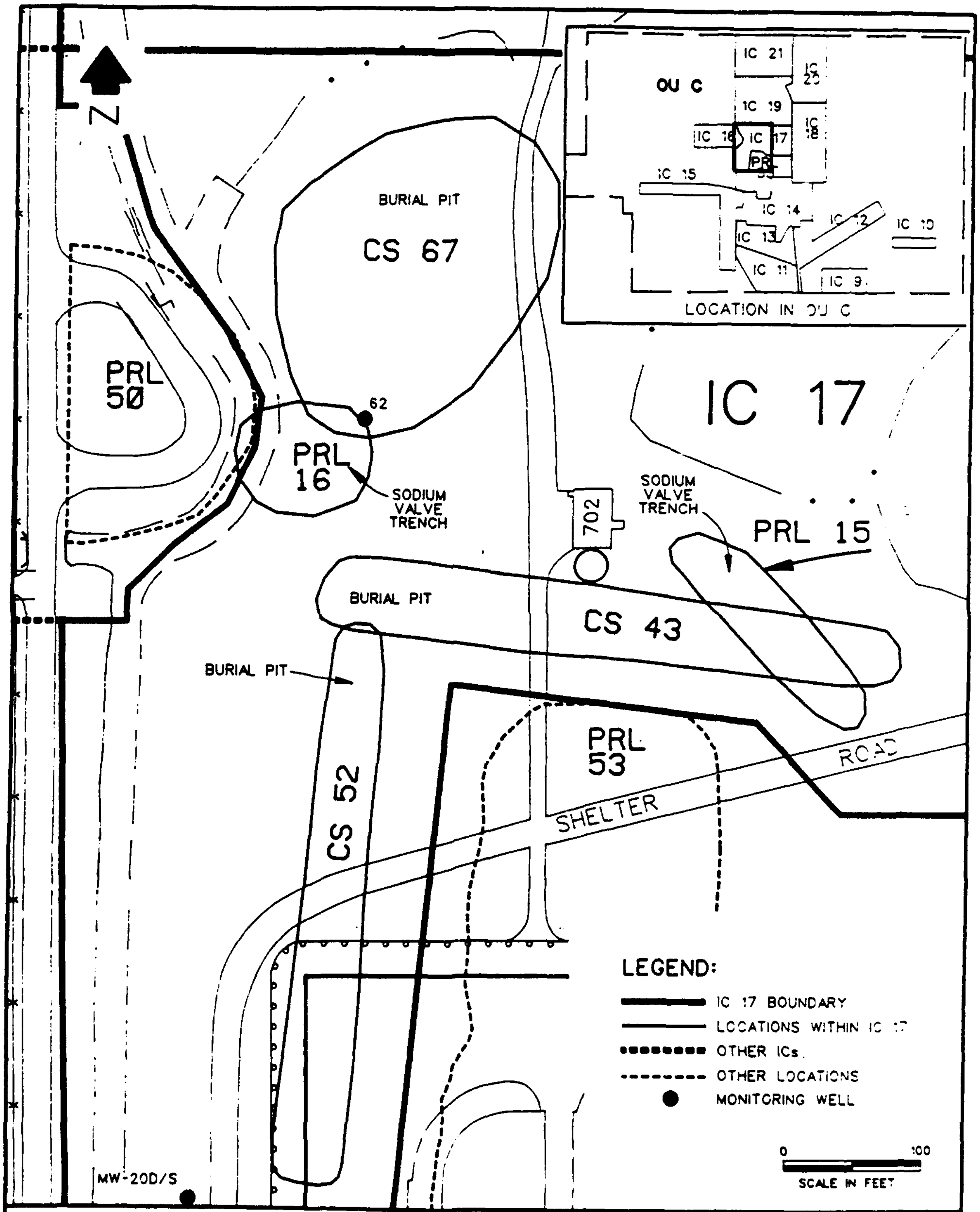


Figure 5.9-1. Potential Discharge Areas at IC 17

OUC2 IC17PSL CAT 9/17/93

TABLE 5.9-1. PREVIOUS INVESTIGATIONS AT IC 17

Year, Contractor	Scope of Investigations	Key Findings
1982, Engineering Science	Installed the dual-completion well MW-20S/D downgradient of CS 43.	Before MW-20S went dry in 1985, its groundwater samples contained benzene, ethylbenzene, toluene, anthracene, naphthalene, and fluorene.
1985, McLaren Environmental Engineers	Investigation of potential contamination at CSs 43, 52, 67, and PRLs 15 and 16. GPR surveys were conducted at CS 43, PRLs 15 and 16. A total of 74 borings were drilled.	Investigation was unable to locate PRLs 15 and 16; possible locations were redefined. AVOC, HVOC, SVOC, TPH, PCB and inorganic contaminants were reported in soil samples from CS 43, CS 52, and CS 67. Boundaries of the CSs were delineated, although not always clearly, from GPR.
1987, Radian Corporation	Solid waste assessment test of CS 43. Six soil gas probes were placed in and around the CS, at depths of 4-7 feet.	Low levels of PCE, TCE, carbon tetrachloride and methyl chloroform were detected. Benzene was reported at 600 ppbv in one probe.
1988, Radian Corporation	Basewide investigation of stream water and sediments for potential organic and inorganic contamination. Samples were collected from Don Julio Creek in IC 17.	Water samples contained <6 mg/L of oil/grease and TPH. Sediment samples contained dichlorofluoromethane, phenol, cadmium, and oil/grease.
1993, CH2M Hill	Preliminary Assessment of sites and locations in OU C.	Identified areas to be investigated in OU C through records review, site visits, and interviews with base personnel.
Ongoing, Radian Corporation	Groundwater sampling and analysis program to determine groundwater contaminant concentrations.	Concentrations of TCE and 1,2-DCE have been reported in MW-62 located at the southern end of CS 67.

NOTE: Acronyms are defined in the acronym list at the beginning of the SAP.

TABLE 5.9-2. DATA QUALITY OBJECTIVES FOR CS 43, CS 52, AND CS 67

Problem Statement

Materials disposed in burial pits at CSs 43, 52, and 67 may have contaminated the subsurface and groundwater.

Decision to be Made

- Determine if contaminants have migrated vertically from the pits.
- Determine the location priority.

Inputs to Decision

Level II/III data for organic and inorganic constituents in soil; Level II/III for soil gas.

Boundaries of the Study

Soil gas samples from approximately 20 to 40 feet BGS; waste samples from within the burial pit; and soil samples from approximately 2 to 30 feet BGS in and beneath the pits.

Decision Rule

- If VOCs are reported in the soil gas and if concentrations are greater than adjacent or surrounding borings, the contamination may have originated at this location.
- If organic contaminants are reported in the soil beneath the waste material, then contaminants have migrated from the burial pit.
- If inorganic species are reported in samples of waste material and if the same suites of species are reported above subsurface background concentrations in soil samples from beneath the waste material, then inorganic contaminants may have migrated from the burial pit, and the decision process for inorganic species should be applied.
- If all data collected are validated, proceed to Data Evaluation DQOs (see Section 4.2.2).

Limits on Uncertainty

Analytical data must meet project specifications for precision and accuracy.

Sample Design

Borings SB1, SB2, SB3, SB4, SB5, SB6, SB8, SB12, and SB14 will be drilled approximately 100 feet apart through the disposal pits. Samples will be collected from within the waste material to characterize the contents, and approximately 10 feet beneath the bottom of the pits to determine if contaminants in the pits have migrated vertically.

(Continued)

TABLE 5.9-2. (Continued)

DATA QUALITY OBJECTIVES FOR PRLs 15 AND 16

Problem Statement

Sodium valves may have been disposed into the pits at PRLs 15 and 16.

Decision to be Made

- Determine if the burial pits exist.
- Determine if contaminants are present in the pit.
- Determine the location priority.

Inputs to Decision

Level II/III data for VOCs in soil gas; Level III data for organic and inorganic constituents in soil.

Boundaries of the Study

Soil gas samples will be collected from approximately 20 to 40 feet BGS; soil samples will be collected from 10 to 20 feet BGS.

Decision Rule

- If physical evidence of waste or disturbed soil is found, together with positive analytical data, then the location was used as a burial pit.
- If organic compounds are reported in soil samples, then the subsurface is contaminated.
- If inorganics are reported above subsurface background concentrations in soil samples, then inorganic contamination may exist and the decision process for inorganic species should be applied.
- If VOCs are reported in the soil gas and if concentrations are greater than adjacent or surrounding borings, the contamination may have originated at this location.
- If all data collected are validated, proceed to Data Evaluation DQOs (see Section 4.2.2).

Limits on Uncertainty

Analytical data must meet project specifications for precision and accuracy.

Sample Design

Borings SB2, SB12, and SB14 will be drilled at 100-foot intervals through the suspected locations of the burial pits.

(Continued)

TABLE 5.9-2. (Continued)

DATA QUALITY OBJECTIVES FOR DRAINAGE CREEKS AND DON JULIO CREEK

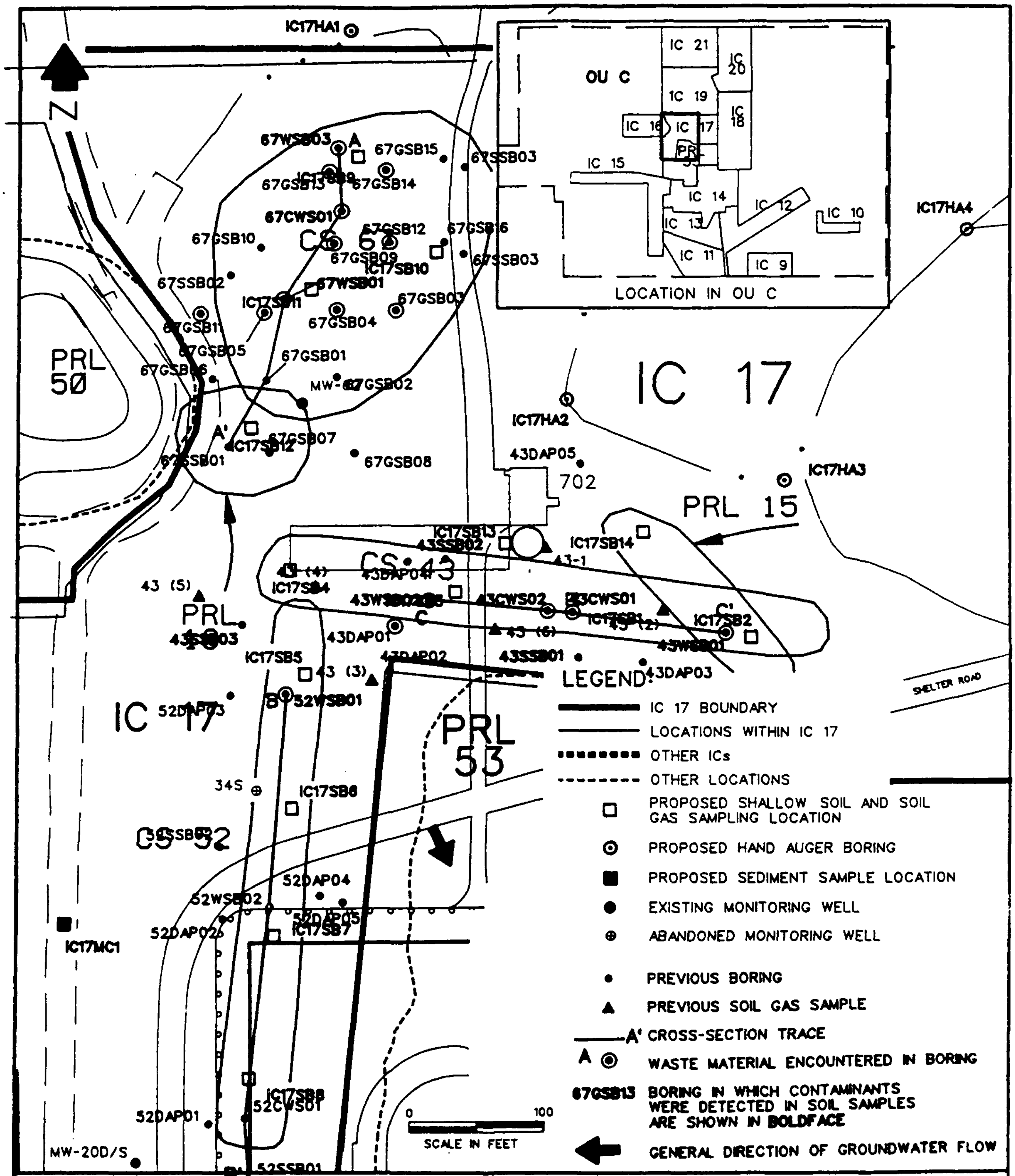
Problem Statement Contaminants may have flowed into the drainage ditch and creek and contaminated sediments and the subsurface.
Decision to be Made • Determine if organic or inorganic species have entered the creek sediments. • Determine the location priority.
Inputs to the Decision Level III data for organic and inorganic species in soil.
Boundaries of the Study Soil samples will be collected from the creekbed to 5 feet below the creekbed.
Decision Rule • If organic species are reported, sediments or soil are contaminated. • If inorganic species are reported above background concentrations, the sediments may be contaminated and the decision process for inorganic species should be applied. • If all data collected are validated, proceed to Data Evaluation DQOs (see Section 4.2.2).
Limits on Uncertainty Analytical data must meet project specifications for precision and accuracy.
Sample Design Hand augers HA1-HA4 will be placed on deposition banks of curves and confluences in the creek. Surface scrape MC1 will be placed in Don Julio Creek within the boundaries of IC 17.

(Continued)

TABLE 5.9-2. (Continued)

DATA QUALITY OBJECTIVES FOR TANK 702 IN IC 17

Problem Statement   Diesel fuel may have leaked from the underground tank or associated piping.
Decision to be Made   • Determine if leaks in the tank or piping have contaminated the soil with TPH.   • Determine if the soil gas is contaminated.   • Determine the location priority.
Inputs to the Decision   Level II/III data for soil gas; Level III for organic constituents in soil.
Boundaries of the Study   Soil gas samples will be collected from 20 to 40 feet BGS; soil samples will be collected from 10 to 30 feet BGS.
Decision Rule   • If petroleum hydrocarbons are reported in the soil adjacent to and/or beneath the tank, leaks from the tanks have contaminated the subsurface.   • If all data collected are validated, proceed to Data Evaluation DQOs (see Section 4.2.2).
Limits on Uncertainty   Analytical data must meet project specifications for precision and accuracy.
Sample Design   Boring B13 will be placed adjacent to estimated location of tank and piping.



Overlay A. Previous Sampling Locations

Figure 5.9-2. Proposed Sampling Locations at IC 17

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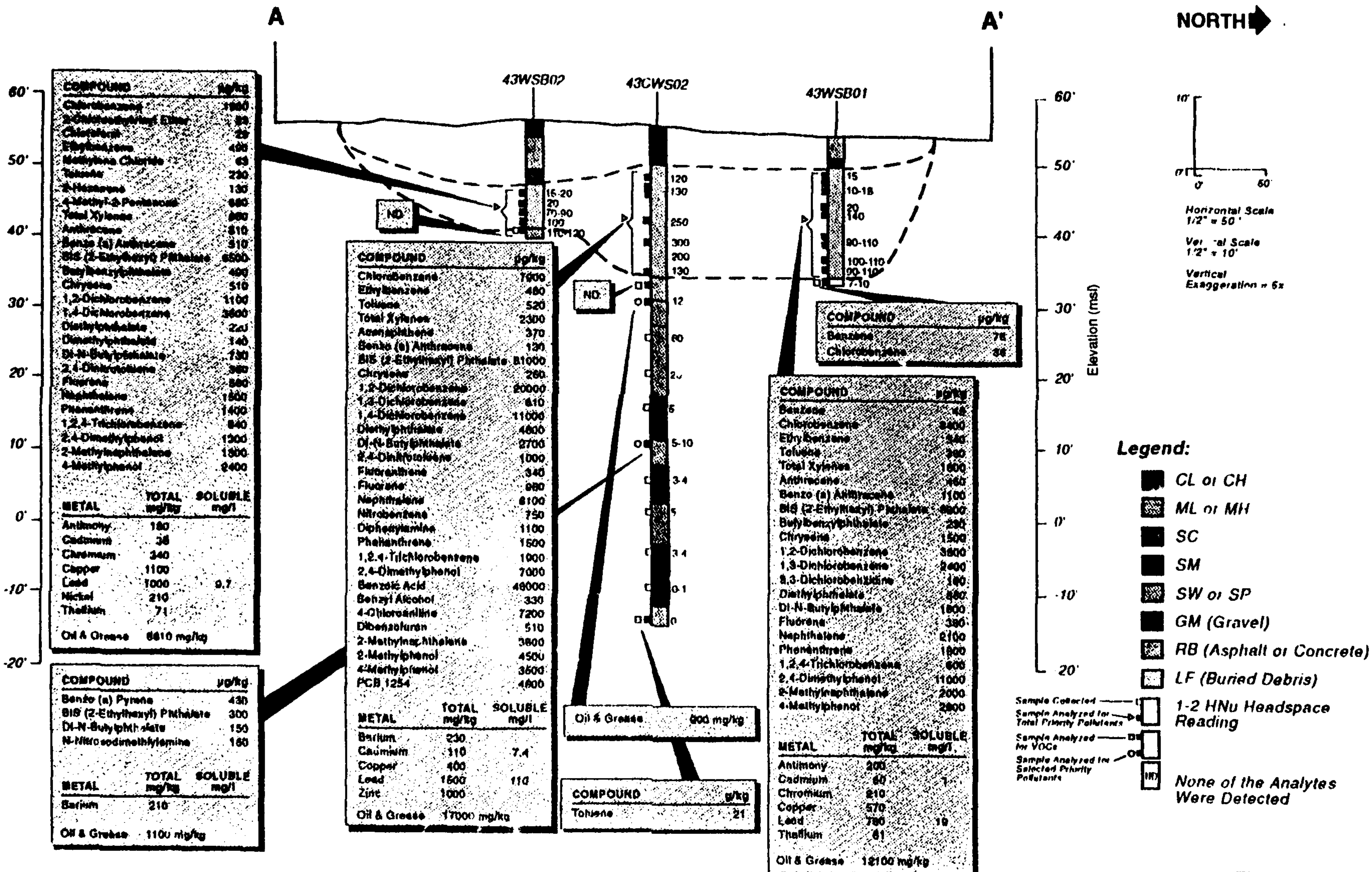
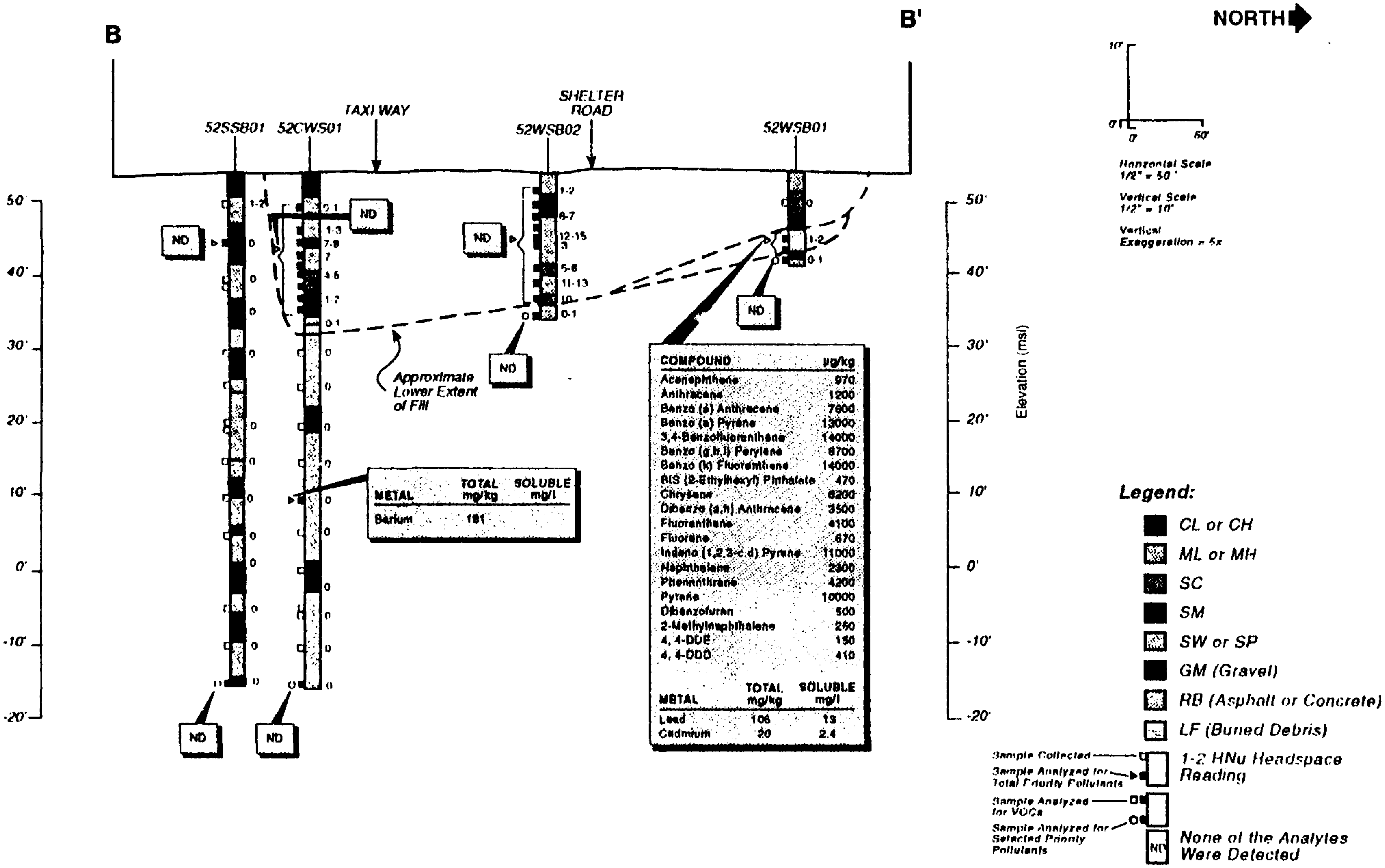


Source: McLaren Environmental Engineering, 1986
OUCX5.FH3 - VMG 2/21/94 SAC

Figure 5.9-3
Cross Section with Positive Analytical Results
CS 43: Burial and Disposal Pits



Source. McLaren Environmental Engineering, 1986
OUCX6.FH3 · VMG 2/21/94 SAC

Figure 5.9-4
Cross Section with Positive Analytical Results
CS 52: Burial and Disposal Pits

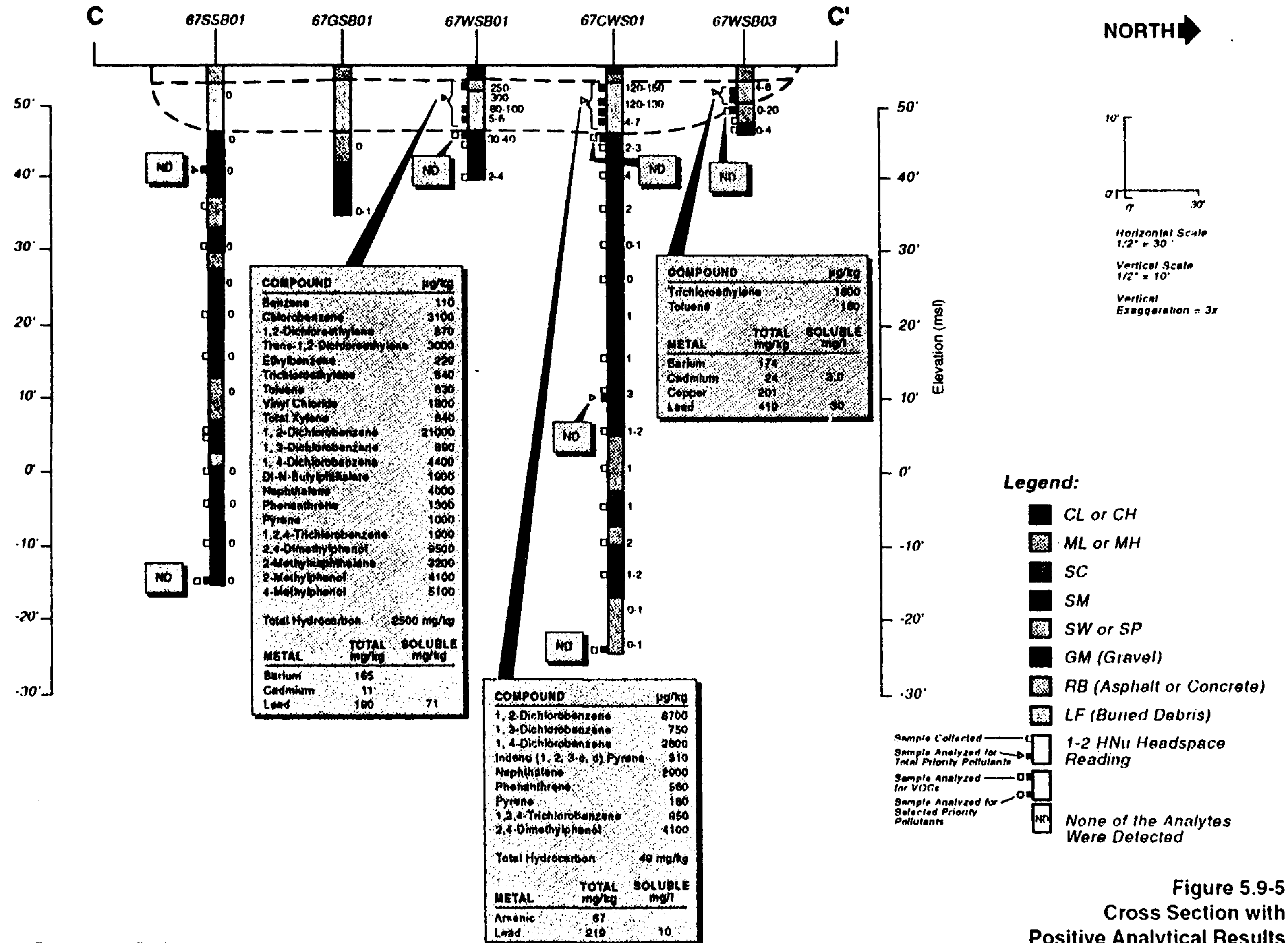


Figure 5.9-5
Cross Section with Positive Analytical Results CS 67: Burial and Disposal Pits

Source: McLaren Environmental Engineering
OUCX7.FH3 · VMG 2/21/94 SAC

TABLE 5.9-3. SAMPLING AND ANALYSIS MATRIX FOR IC 17

Location:	CS 43		CS 52		CS 67
Contaminant of Concern:	VOCs, SVOCs, Inorganics, PCBs, PAHs, TPH, Dioxins/furans, Cyanide, Acids, Bases		VOCs, SVOCs, Inorganics, PCBs, PAHs, TPH, Dioxins/furans, Cyanide, Acids, Bases		VOCs, SVOCs, Inorganics, PCBs, PAHs, TPH, Dioxins/furans, Cyanide, Acids, Bases
Sampling Location:	Borings SB1, SB2[a]	Borings SB3, SB4	Boring SB5	Borings SB6-SB8	Borings SB9-SB11
Depth and Analytical Method:	(10-20') SW6010, SW7060, SW7471, SW7740, ModSW8015/3550[c], ModSW8015/5030, SW8270[c], E218.6, SW8280[c], SW8080[c], SW8310[c], SW9045, SW9012 (15-20')[b] FGC (30') SW6010, SW7060, SW7471, SW7740, ModSW8015/3550, SW8270, SW8280, SW8080, E218.6, SW8310, SW9045, SW9012, SW1311/SW6010[f], SW1311/SW7060[f], SW1311/SW7471[f], SW1311/SW7740[f] (35-45') FGC	(10-15') SW6010, SW7060, SW7471, SW7740, ModSW8015/3550[c], SW8270[c], SW8080[c], SW8280[c], ModSW8015/5030, SW8310[c], SW9045, SW9012 (15-25') FGC (25') SW6010, SW7060, SW7471, SW7740, ModSW8015/3550, ModSW8015/5030, SW8270, SW8080, SW8280, SW8310, SW9045, SW9012, SW1311/SW6010[f], SW1311/SW7060[f], SW1311/SW7471[f], SW1311/SW7740[f] (35-45') FGC	(7-12') SW6010, SW7060, SW7471, SW7740, ModSW8015/3550[c], SW8270[c], SW8080[c], ModSW8015/5030, E218.6, SW8310[c], SW9045, SW9012 (15-25') FGC (15') SW6010, SW7060, SW7471, SW7740, ModSW8015/3550, ModSW8015/5030, SW8270, SW8080, SW8280, E218.6, SW8310, SW9045, SW9012, SW1311/SW6010[f], SW1311/SW7060[f], SW1311/SW7471[f], SW1311/SW7740[f] (35-45') FGC	(15') SW6010, SW7060, SW7471, SW7740, ModSW8015/3550, SW8270, SW9045, SW9012, SW1311/SW6010[f], SW1311/SW7060[f], SW1311/SW7471[f], SW1311/SW7740[f] (15-25') FGC (35-45') FGC	(2-8') SW6010, SW7060, SW7471, SW7740, ModSW8015/3550[c], SW8270[c], SW8080[c], SW8280[c], ModSW8015/5030, E218.6[d], SW9045, SW9012 (15-25') FGC (20') SW6010, SW7060, SW7421, SW7471, SW7740, ModSW8015/3550, ModSW8015/5030, SW8270, SW8080, SW8280, E218.6[d], SW8310, SW9045, SW9012, SW1311/SW6010[f], SW1311/SW7060[f], SW1311/SW7471[f], SW1311/SW7740[f] (35-45') FGC

(Continued)

TABLE 5.9-3. (Continued)

Location:	PRL 15	PRL 16	Don Julio Creek	Drainage Ditch	Tank 702
Contaminant of Concern:	VOCs, Inorganic species, TPH (Because of the proximity to CS 43, additional contaminants of concern may be SVOCs, PAHs, PCBs, and dioxins/furans. Samples, therefore, will be analyzed for CS 43 contaminants of concern.)	VOCs, Inorganic species, TPH (Because of the proximity to CS 43, additional contaminants of concern may be SVOCs, PAHs, PCBs, and dioxins/furans. Samples, therefore, will be analyzed for CS 67 contaminants of concern.)	SVOCs, TPH, Inorganic species	SVOCs, TPH, Inorganic species	VOCs, TPH
Sampling Location:	Boring SB14	Boring SB12	MC1[e]	Hand Augers HA1-HA4	Boring SB13
Depth and Analytical Method:	(10-15') SW6010, SW7060, SW7471, SW7740, ModSW8015/3550[c], ModSW8015/5030, SW8270[c], SW8080[c], SW8280[c], SW8310[c], SW9045, SW9012	(10-15') SW6010, SW7060, SW7471, SW7740, ModSW8015/3550[c], ModSW8015/5030, SW8270[c], SW8080[c], SW8280[c], SW8310[c], SW9045, SW9012	(0-0.25') SW6010, ModSW8015/3550, SW8270	(0-0.25') ModSW8015/3550[e], SW6010[e]	(10') ModSW8015/3550
	(15-25') FGC	(15-25') FGC			(15-25') FGC
	(25') SW6010, SW7060, SW7471, SW7740, ModSW8015/3550, ModSW8015/5030, SW8270, SW8080, SW8280, SW8310, SW9045, SW9012, SW1311/SW6010[f], SW1311/SW7060[f], SW1311/SW7471[f], SW1311/SW7740[f]	(20') SW6010, SW7060, SW7471, SW7740, ModSW8015/3550, ModSW8015/5030, SW8270, SW8080, SW8280, SW8310, SW9045, SW9012, SW1311/SW6010[f], SW1311/SW7060[f], SW1311/SW7471[f], SW1311/SW7740[f]		(1') SW8270	(20') ModSW8015/3550
	(35-45') FGC	(35-45') FGC			
				(5') ModSW8015/3550, SW8270, SW6010	(30') ModSW8015/3550
					(35-45') FGC

(Footnotes presented on following page.)

TABLE 5.9-3. (Continued)

[a] Analytical results from samples collected at Boring SB2 will also provide data for PRL 15.
[b] Soil gas sample will be collected in the waste material.
[c] 4:1 composite sample. Samples will be collected over the interval specified and composited for analysis. Inorganic samples (not composited) will be collected at the bottom of the interval.
[d] SB9 and SB11 only.
[e] 5:1 composite sample.
[f] The sample yielding the highest concentration of inorganic constituents relative to the constituent's toxicity (see Section 4.3.2) in each pit will be analyzed for soluble metal concentrations.

FGC = Screening analysis of soil gas for commonly detected VOCs with on-site chromatograph.

NOTE: Matrix represents the minimum number of samples to be collected in each horizon
FGC analyses will be confirmed with 10% TO-14 analyses.
All acronyms are defined on the acronym list at the beginning of the SAP.
Specific sample depths will be determined in the field using the sampling criteria specified in Section 4.

TABLE 5.9-4. SAMPLING AND FIELD SPECIFICATIONS FOR IC 17

Boring Location	Reference Point	Distance	Maximum Depth Interval (ft BGS)
Sediment Sample			
MC1	MW-34S	99'S, 141'W	0.25
Hand Augers			
HA1	Northwest corner of Bldg. 702	332'N, 119'W	5
HA2	Northwest corner of Bldg. 702	52'N, 14'E	5
HA3	Southwest corner of Bldg. 702	33'N, 174'E	5
HA4	MW-44S	133'N, 4'E	5
Borings			
SB1	Southeast corner of Bldg. 702	56'S, 19'E	45
SB2	Southeast corner of Bldg. 702	84'S, 151'E	45
SB3	Southwest corner of Bldg. 702	49'S, 40'W	45
SB4	Southwest corner of Bldg. 702	33'S, 160'W	45
SB5	MW-34S	87'N, 37'E	45
SB6	MW-34S	13'S, 27'E	45
SB7	MW-34S	108'S, 15'E	45
SB8	Northwest corner of Bldg. 704	177'N, 148'W	45
SB9	MW-62	187'N, 39'E	45
SB10	Northwest corner of Bldg. 702	165'N, 57'W	45
SB11	Northwest corner of Bldg. 702	136'N, 147'W	45
SB12	MW-82	17'S, 38'W	45
SB13	Southwest corner of Bldg. 702	14'S, 4'W	45
SB14	Southeast corner of Bldg. 702	9'S, 72'E	45

FFF-13

5.10 Field Sampling Plan for Investigation Cluster (IC) 18 (Potential Release Location [PRL] 49, PRL 66C, and PRL L-7C)

Investigation Cluster 18 comprises PRL 49, PRL 66C, and a section of the Industrial Wastewater Line (IWL) (PRL L-7C). All three sites trend north/south through the central portion of OU C (Figure 5.10-1).

Potential Release Location 49 was identified as a surface depression in aerial photographs and was reported to be a covered burial pit (McLaren, 1986b). There is no information concerning quantities or types of waste disposed at the site. A 1985 investigation did not locate areas of disturbed soil or detect contaminants in the soil (Table 5.10-1).

Potential Release Location 66C includes the drainage area directly behind Buildings 772, 773, 7603, 7605, and 7606. These buildings are test stands and hush houses, and are first visible in aerial photographs taken in 1972. The drainage area extends approximately 150 feet to the west and is mostly covered by asphalt and concrete. Prior to installation of the IWL in 1988, PRL 66C received all the drainage from testing and maintenance operations in the test stands and hush houses.

Potential Release Location L-7C is approximately 1,500 feet long and carries liquid waste from OU D and from the test stands and hush houses to the Industrial Wastewater Treatment Plant (IWTP). Wastewater is collected in trenches near the back of the buildings and is released by gravity flow to the IWL. A small sump is located west of Building 7606. At one time, the sump drained to a ditch west of the building (EG&G Idaho, 1988). Currently, the sump is connected to the IWL.

Previous investigations conducted at IC 18 are summarized in Table 5.10-1.

5.10.1 Data Quality Objectives

The data quality objectives of this stage of the Remedial Investigation (RI) at IC 18 are shown on Table 5.10-2.

5.10.2 Sampling Plan

Proposed sampling locations are shown on Figure 5.10-2. Overlay A shows previous sampling locations. Potential contaminants of concern and the sampling and analysis matrix for IC 18 are shown in Table 5.10-3; field specifications for sampling locations are included in Table 5.10-4.

Rationale and specific objectives for sampling locations are outlined below.

Soil gas samples will be collected from approximately 20 to 100 feet BGS in borings SB6 and SB14. A groundwater sample will be collected in each boring with a HydroPunch®. These borings will be converted to groundwater monitoring wells to determine water quality and groundwater flow directions. Monitoring wells in this area were recommended in the Draft Groundwater OU RI/FS.

Ten borings (SB1 through SB6, and SB18 through SB21) will be drilled and sampled along the IWL to identify areas where leaks may have contaminated the subsurface. The borings are located at manholes, next to known cracks or breaks, and at 100-foot intervals in areas rated in the 1993 IWL investigation as having a high or moderate potential for leakage (SB18 through SB21).

Borings SB3 through SB5 are also located within the boundaries of PRL 49. Soil samples will be collected from these borings to determine if wastes were buried at PRL 49 and if these materials have contaminated the subsurface.

Eleven borings (SB7 through SB17) will be drilled and sampled adjacent to the sumps that collect wastewater from the test stands and hush houses. Analytical results from these samples will indicate if leaks in the sumps and/or drainage from the buildings have contaminated PRL 66C. Because the sumps are spaced closely together (about 50 feet apart), Phase I borings will be drilled at approximately every other sump. If analytical results indicate this is a source area of contamination, additional borings may be added at the alternate sumps during Phase II.

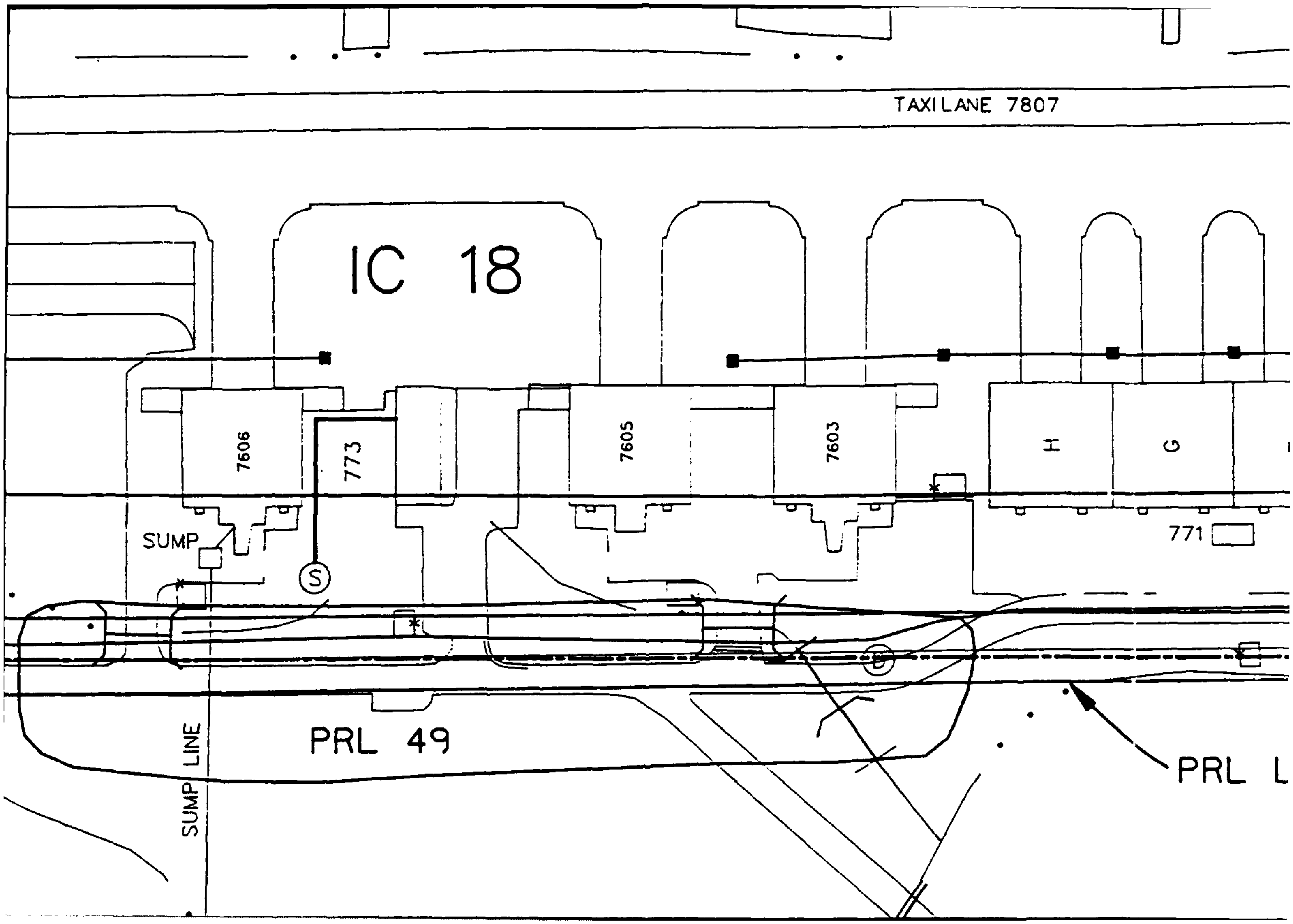
Boring SB17 is also located near the sump servicing Building 7606. Both soil and soil gas samples will be collected to determine if the sump leaked and contaminated the subsurface.

Five hand augers (HA1 through HA5) are located in open drainage areas (low spots) of PRL 66C. Samples will help determine whether spills or washwater from the buildings have contaminated the surface soils.

Hand auger HA6 is located in the drainage adjacent to the outfall from the sump line behind Building 7606. Samples will be analyzed to determine if contaminants were released from the drain outlet into drainage sediments.

Eleven hand augers (HA2, and HA7 through HA16) are located in the drainage ditches at IC 18 to determine if any contaminants have entered the ditches in runoff from the test stands and hush houses. Surface soil samples will also be collected at Borings SB2 and SB18 for the same purpose.

Physical parameter samples will be collected from different soil types in SB6 and SB14 to provide information for vadose zone modeling and for evaluation of remedial alternatives.


TAXILANE 7807
IC 18
7606
773
7605
7603
H
G
SUMP
771
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D
PRL 49
SUMP LINE
PRL L

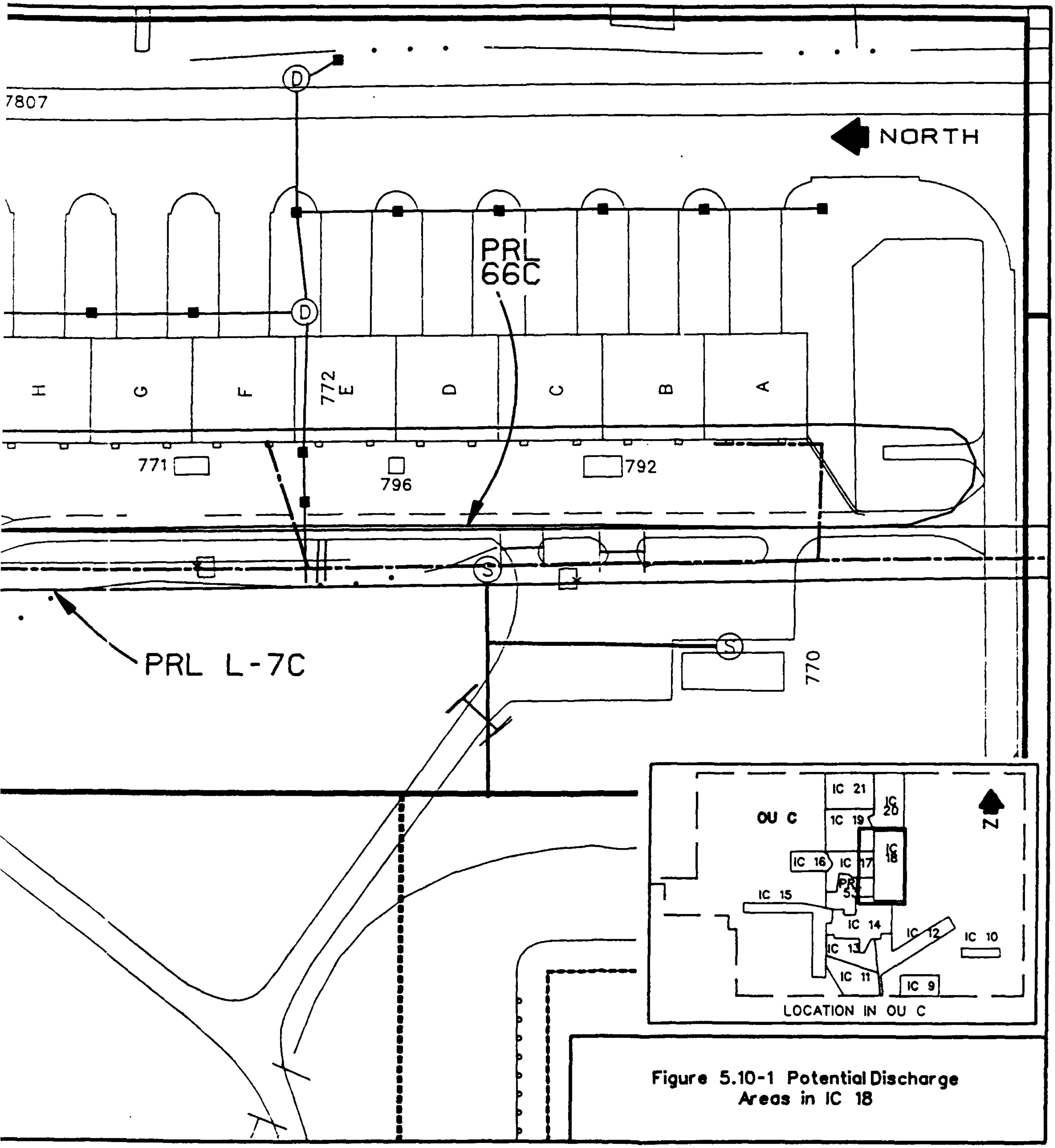


Figure 5.10-1 Potential Discharge Areas in IC 18

OUC2 IC18PDA SAC 9/23/93

2)

TABLE 5.10-1. PREVIOUS INVESTIGATIONS AT IC 18

Year, Contractor	Scope of Investigation	Key Findings
1985, McLaren Environmental Engineers	Investigation of potential contamination at PRL 49. Three waste sample borings were drilled and sampled.	Borings penetrated undisturbed soil profiles and HNu® readings of zero. No contamination or buried waste reported.
1993, CH2M HILL	Preliminary Assessment of sites and locations in OU C.	Identified area to investigate through records review, site visits, and interviews with base personnel.
1993, Jacobs Engineering Group	Investigation of the IWL.	Rated the section of line between MH-4C and MH-4E as having a moderate potential for leakage.

NOTE: All acronyms are defined in the acronym list at the beginning of the SAP.

TABLE 5.10-2. DATA QUALITY OBJECTIVES FOR PRL 49

Problem Statement

Hazardous waste may have been disposed into the pit at PRL 49.

Decision to be Made

- Determine if the burial pit exists.
- Determine if contaminants are present in the pit.
- Determine the location priority.

Inputs to Decision

Level II/III for VOCs in soil gas; Level III for SVOCs, TPH, and inorganics in soil.

Boundaries of the Study

Soil gas samples will be collected from approximately 20 to 40 feet BGS. Subsurface soil samples will be collected from 10 to 20 feet BGS within the boundaries of PRL 49.

Decision Rule

- If physical evidence of waste or disturbed soil is found, together with positive analytical data, then the location was used as a burial pit.
- If suites of VOCs reported in soil gas surrounding the pit are similar to suites of VOCs reported in soil gas from within the pit, and if concentrations decrease with distance from the pit horizontally, then the VOC contamination most likely originates at the pit.
- If organic compounds are reported in soil samples, then the subsurface is contaminated.
- If inorganics are reported above subsurface background concentrations in soil samples, then inorganic contamination may exist and the decision process for inorganic species should be applied.
- If data collected are validated, then proceed to Data Evaluation DQOs (see Section 4.2.2).

Limits on Uncertainty

Analytical data must meet project specifications for precision and accuracy.

Sampling Design

Borings SB3–SB5 will be drilled at manhole locations along the IWL through the center of PRL 49.

(Continued)

TABLE 5.10-2. (Continued)

DATA QUALITY OBJECTIVES FOR SOIL AND SOIL GAS AT PRL 66C

Problem Statement

Contaminants may have spilled or washed onto the surface, and/or drained into the subsurface at PRL 66C.

Decision to be Made

- Determine if the surface and/or subsurface has been contaminated by materials that have drained from the nearby hush houses and test stands.
- Determine if sumps west of the buildings have contaminated the subsurface.
- Determine the location priority.

Inputs to the Decision

Level II/III for VOCs in soil gas; Level III for SVOCs, TPH, and inorganic species in soil.

Boundaries of the Study

Soil gas samples will be collected from approximately 20 to 100 feet BGS. Soil samples will be collected at surface to 20 feet BGS.

Decision Rule

- If organic compounds are reported in soil samples, then the surface and/or subsurface has most likely been contaminated by drainage from test stands and hush houses or leaks in the sumps.
- If inorganic species are reported above background concentrations, then inorganic contamination may exist and the decision process for inorganic species should be applied.
- If suites of VOCs reported in soil gas surrounding the test cells and hush houses are similar to suites of VOCs reported in soil gas adjacent to the sumps, and if concentrations decrease with distance from the sumps horizontally, then VOC contamination most likely originates at the sump.
- If VOC concentrations are low or not detected in the shallow soil gas (<40 feet BGS), but are reported or increase with depth in the deep soil (>40 feet BGS), the soil gas contamination is probably from the smear zone left by declining water levels.
- If all data collected are validated, proceed to Data Evaluation DQOs (see Section 4.2.2).

Limits on Uncertainty

Analytical data must meet project specifications for precision and accuracy.

Sampling Design

Borings SB7–SB17 will be drilled from adjacent to approximately every other sump (due to the close proximity of the sumps). Hand augers HA1–HA5 will be drilled in the open drainage areas of PRL 66C.

(Continued)

TABLE 5.10-2. (Continued)

DATA QUALITY OBJECTIVES FOR SOIL AND SOIL GAS AT PRL L-7C

Problem Statement

Wastewater carried in the IWL (PRL L-7C) may have leaked and contaminated the subsurface.

Decision to be Made

- Determine if leaks in the IWL (PRL L-7C) and/or the sump have contaminated the soil gas.
- Determine the location priority.

Inputs to the Decision

Level II/III for VOCs in soil gas.

Boundaries of the Study

Soil gas samples from approximately 10 to 100 feet BGS along the IWL.

Decision Rule

- If organics compounds are detected in the surface and near surface soils of the drianage ditch, then the ditch sediments are contaminated.
- If inorganic species are reported above background concentrations, then sediments may be contaminated and the decision process for inorganic species should be applied.
- If VOCs are reported in soil gas along the IWL, and if concentrations decrease with distance from the line horizontally and with depth, then VOC contamination most likely originates at the IWL.
- If VOC concentrations are low or not detected in the shallow soil gas (<40 feet BGS), but are reported or increase with depth in the deep soil (>40 feet BGS), the soil gas contamination is probably from the smear zone left by declining water levels.
- If suites of VOCs are similar with depth, then VOCs have most likely migrated vertically.
- If all data collected are validated, proceed to Data Evaluation DQOs (see Section 4.2.2).

Limits on Uncertainty

Analytical data must meet project specifications for precision and accuracy.

Sample Design

Borings will be placed at locations of manholes (SB1-SB6), known cracks or breaks, and sections rated in the 1993 IWL investigation as having a high or moderate potential for leakage (SB18-SB21). Borings SB7-SB17 will be drilled from adjacent to approximately every other sump (due to the close proximity of the sumps). Borings SB12 and SB18 will be drilled where the drainage ditch and IWL intersect.

(Continued)

TABLE 5.10-2. (Continued)

DATA QUALITY OBJECTIVES FOR GROUNDWATER BENEATH IC 18

Problem Statement Data on groundwater flow directions and contaminant migration in western OU C are sparse.
Decision to be Made • Determine groundwater flow directions. • Determine if the groundwater beneath the location is contaminated. • Determine the location priority.
Inputs to the Decision Level III data for groundwater. Previous groundwater flow and contaminant data.
Boundaries of the Study Groundwater samples from the A monitoring zone.
Decision Rule • Contaminants from the location have contaminated the groundwater if all of the following are true: — Organic compounds above background are reported in groundwater samples downgradient of the location, — Those suites of compounds are also reported in soil gas beneath the location, and — Those compounds or species are not reported or are reported at lower concentrations in upgradient samples. • If all data collected are validated, proceed to Data Evaluation DQOs (see Section 4.2.2).
Limits on Uncertainty Analytical data must meet project specifications for precision and accuracy.
Sample Design Borings SB6 and SB14 will be drilled to groundwater and sampled. Both will be converted to monitoring wells, developed, and resampled.

(Continued)

TABLE 5.10-2. (Continued)

DATA QUALITY OBJECTIVES FOR DRAINAGE DITCHES IN IC 18

Problem Statement

Contaminants from locations in IC 18 may have run off and contaminated the sediments and the subsurface in drainage ditches.

Decision to be Made

- Determine if organic or inorganic species have entered the drainage ditches.
- Determine the location priority.

Inputs to the Decision

Level III for SVOCs, TPH, and inorganics in soil.

Boundaries of the Study

Soil samples will be collected from the bottom of the ditch or swale to 5 feet below the bottom of the ditch.

Decision Rule

- If organic species are reported in soil samples, then sediments or soil are contaminated.
- If inorganic species are reported above background concentrations, then sediments may be contaminated and the decision process for inorganic species should be applied.
- If all data collected are validated, proceed to Data Evaluation DQOs (see Section 4.2.2).

Limits on Uncertainty

Analytical data must meet project specifications for precision and accuracy.

Sample Design

Hand augers HA7–HA11 will be collected in drainage ditches at bends, confluences, and exit points. Hand auger HA6 will be located at the outfall of the sump line from Building 7606. Surface soil samples will be 5:1 composite samples.

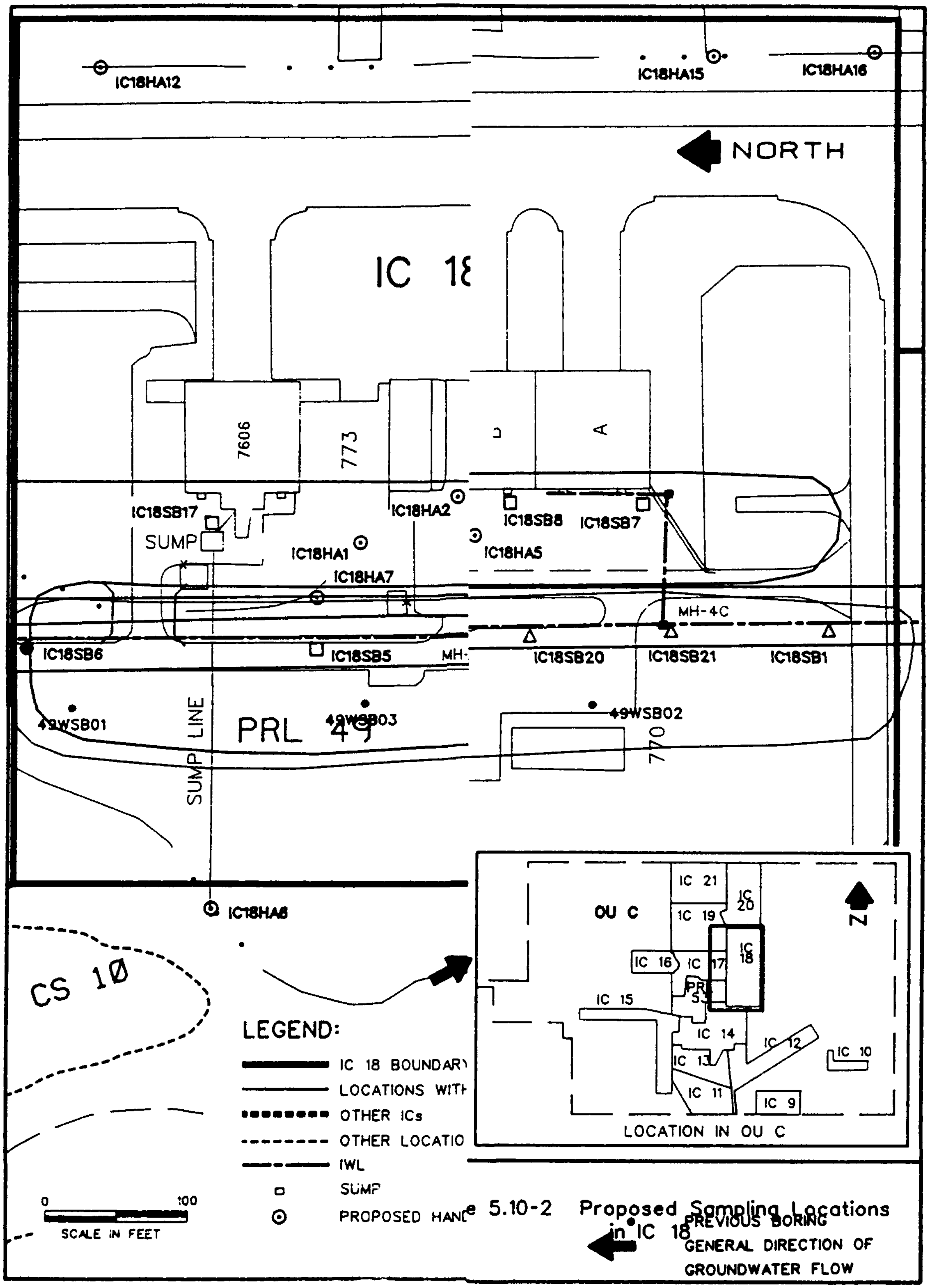
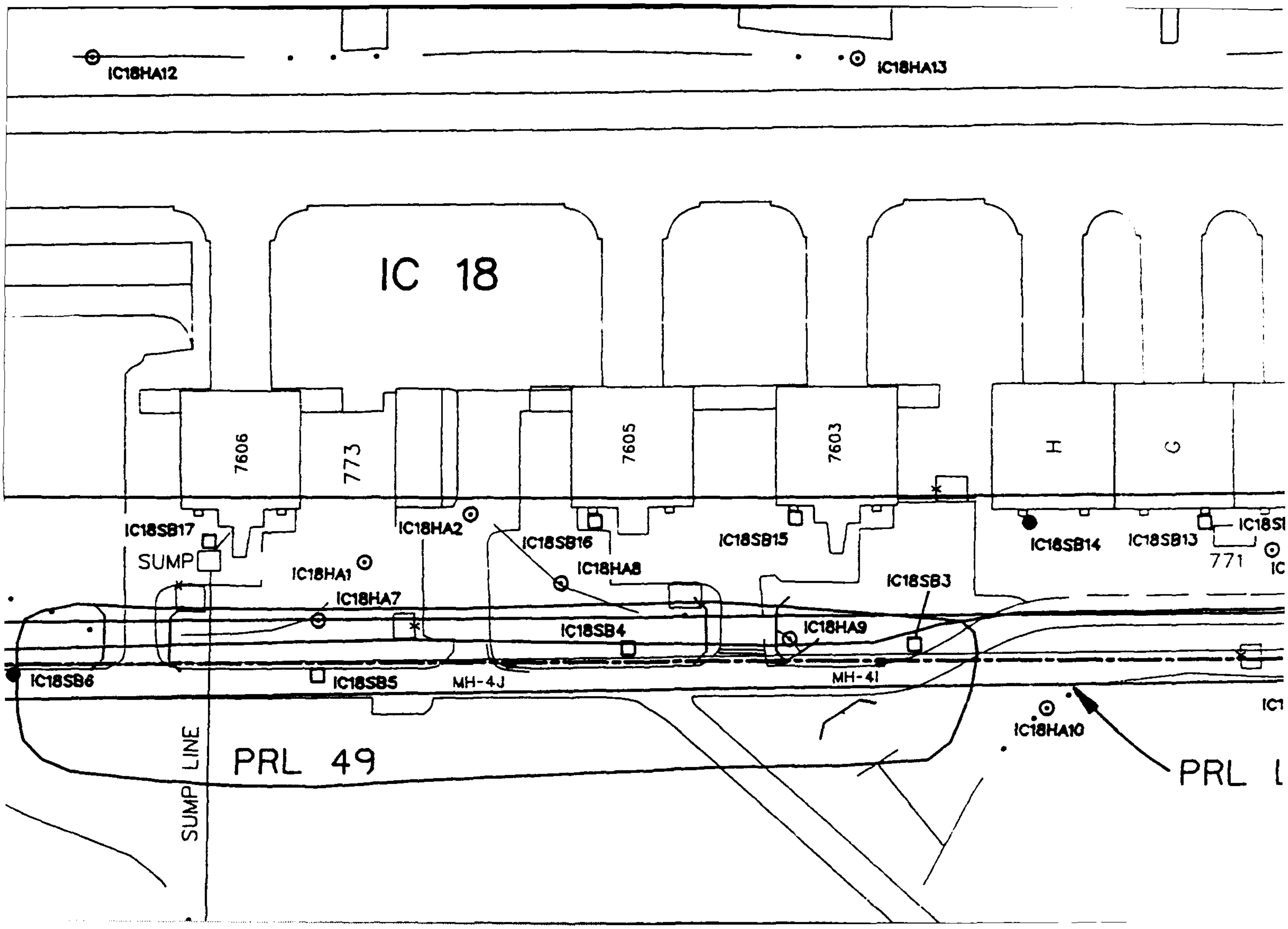


Figure 5.10-2 Proposed Sampling Locations in IC 18

OUC4 IC18PSL SAC 2/25/94

Overlay A: Previous Sampling Locations

OUC4 IC18EB SAC 2/22/94



IC18HA12
IC18HA13
IC 18
7606
773
7605
7603
H
G
IC18SB17
SUMP
IC18HA2
IC18SB16
IC18SB15
IC18SB14
IC18SB13
771
IC18HA1
IC18HA8
IC18HA7
IC18SB3
IC18SB4
IC18HA9
IC18SB6
IC18SB5
MH-4J
MH-4I
IC18HA10
SUMP LINE
PRL 49

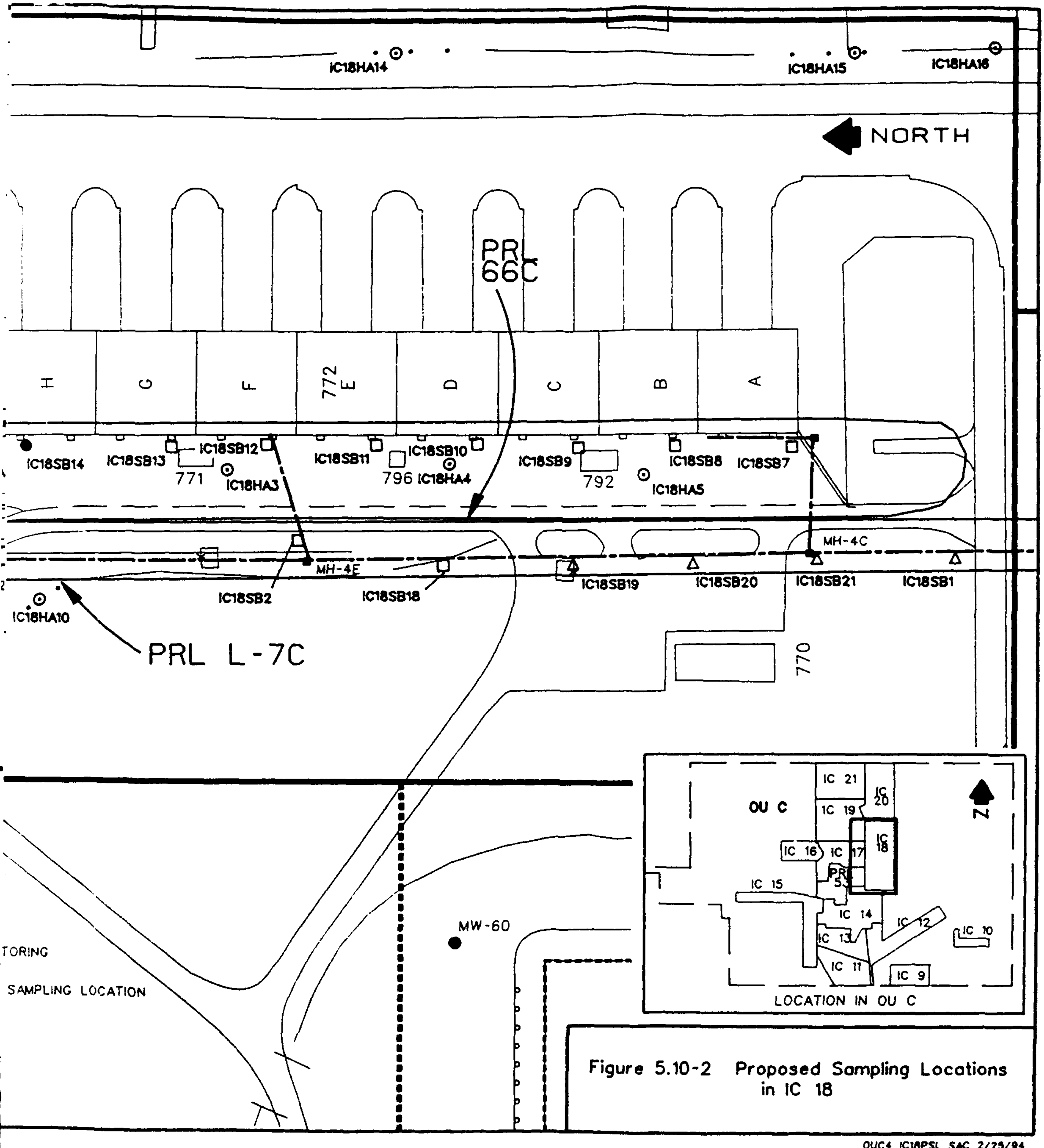


Figure 5.10-2 Proposed Sampling Locations in IC 18

TABLE 5.10-3. SAMPLING AND ANALYSIS MATRIX FOR IC 18

Location:	PRL 49	PRL 66C			PRL L-7C			Drainage Ditch	
Contaminant of Concern:	Unknown	VOCs, TPH, SVOCs, Inorganic species			VOCs, SVOCs, TPH, Inorganic species			SVOCs, TPH, Inorganic species	
Sample Location:	Borings SB3[a]-SB5[a]	Borings SB7-SB13, SB15-SB17	Borings SB14[b]	Hand Augers HA1-HA5	Borings SB1, SB19-SB21	Boring SB6[b,g]	Borings SB2[f], SB18[f]	Hand Augers HA6-HA10,	Hand Augers HA11-HA16
Depth and Analytical Method:	(10') SW6010, ModSW8015/3550, ModSW8015/5030, SW8270	(0-0.25') SW6010, ModSW8015/3550	(0-0.25') SW6010, ModSW8015/3550	(0-0.25') SW6010, ModSW8015/3550		(10') SW6010, ModSW8015/3550, ModSW8015/5030, SW8270	(0-0.25') ModSW8015/3550, SW6010	(0-0.25') ModSW8015/3550[c], SW6010[c]	(0-0.25') ModSW8015/3550[c], SW6010[c]
	(15-25') FGC	(1') SW8270	(1') SW8270	(1') SW8270		(15-25') FGC	(1') SW8270	(1') SW8270	(1') SW8270
	(20') SW6010, ModSW8015/3550, ModSW8015/5030, SW8270	(5') SW6010, ModSW8015/3550, ModSW8015/5030, SW8270	(5') SW6010, SW8270 ModSW8015/3550, ModSW805/5030	(5') SW6010, ModSW8015/3550, ModSW8015/5030, SW8270	(15-25') FGC (35-45') FGC	(20') SW6010, ModSW8015/3550, ModSW8015/5030, SW8270	(5') ModSW8015/3550, ModSW8015/5030, SW8270, SW6010	(5') SW6010, ModSW8015/3550, ModSW8015/5030, SW8270	(5') SW6010, ModSW8015/3550, SW8270
	(35-45') FGC	(10') SW6010, ModSW8015/3550, ModSW8015/5030, SW8270	(10') *SW6010, SW8270,* ModSW8015/3550, ModSW8015/5030			(35-45') FGC	(15-[illegible]') FGC		
		(15-25') FGC	(15-25') FGC			(75-85') FGC			
		(35-45') FGC	(35-45') FGC			(90-100') FGC	(35-45') FGC		
			(55-65') FGC			(groundwater) SW8260[d,e]			
			(75-85') FGC						
			(90-100') FGC						
			(groundwater) SW8260[d,e]						

(Footnotes presented on following page.)

TABLE 5.10-3. (Continued)

[a] Analytical results from samples collected in borings SB3 through SB5 will also provide data for the IWL (PRL L-7C).
[b] Three samples will be collected in each boring (SB6 and SB14) for bulk density analysis (ASTM 2937) in different soil types.
[c] 5:1 composite samples.
[d] For SW8240 analytes.
[e] The benefits and limitations of Method SW8260 are currently being compared with Methods SW8010 and SW8020. Depending on the outcome of this review, Methods SW8010 and SW8020 may be used instead of SW8260.
[f] Borings SB2 and SB18 are located where the drainage ditch and IWL intersect.
[g] Analytical results from boring SB6 will also provide data for PRL 49.

FGC = Screening analysis of soil gas for commonly detected VOCs with on-site chromatograph.

NOTE: Matrix represents the minimum number of samples to be collected in each horizon.
FGC analyses will be confirmed with 10% TO-14 analysis.
Specific sample depths will be determined in the field using the sampling criteria specified in Section 4.
All acronyms are defined on the acronym list at the beginning of the SAP.

TABLE 5.10-4. SAMPLING AND FIELD SPECIFICATIONS FOR IC 18

Boring/Location Name	Reference Point	Distance	Maximum Depth Interval (ft BGS)
Hand Augers			
HA6	Southeast corner of Bldg. 7606	327'S, 35'W	5
HA7	Northwest corner of Bldg. 7606	154'S, 93'W	5
HA8	Southeast corner of Bldg. 7605	50'S, 86'W	5
HA9	Northwest corner of Bldg. 7605	170'S, 144'W	5
HA10	Northwest corner of Bldg. 772	216'S, 36'E	5
HA11	Northwest corner of Bldg. 772	412'S, 106'W	5
HA12	Northeast corner of Bldg. 7606	226'N, 140'W	5
HA13	Southeast corner of Bldg. 7605	222'N, 27'W	5
HA14	Northeast corner of Bldg. 772	227'N, 326'W	5
HA15	Southeast corner of Bldg. 772	310'N, 42'E	5
HA16	Southeast corner of Bldg. 772	313'N, 155'E	5
Borings			
SB1	Southwest corner of Bldg. 772	98'S, 656'E	45
SB2	Southwest corner of Bldg. 771	68'S, 60'W	45
SB3	Northwest corner of Bldg. 7605	175'S, 225'E	45
SB4	Northwest corner of Bldg. 7605	175'S, 38'E	45
SB5	Northwest corner of Bldg. 7606	188'S, 92'E	45
SB6	Northwest corner of Bldg. 7606	190'S, 108'W	100
SB7	Southeast corner of Bldg. 772	9'S, 5'W	45
SB8	Southeast corner of Bldg. 772	9'S, 99'W	45
SB9	Southeast corner of Bldg. 772	9'S, 179'W	45
SB10	Southeast corner of Bldg. 772	9'S, 260'W	45
SB11	Northeast corner of Bldg. 772	99'S, 341'W	45
SB12	Northeast corner of Bldg. 772	94'S, 428'W	45
SB13	Northeast corner of Bldg. 772	99'S, 504'W	45
SB14	Northeast corner of Bldg. 772	99'S, 624'W	100
SB15	Southeast corner of Bldg. 7605	10'S, 68'E	45
SB16	Southeast corner of Bldg. 7605	9'S, 64'W	45
SB17	Northwest corner of Bldg. 7606	18'S, 22'W	45
SB18	Southwest corner of Bldg. 772	104'S, 360'E	45
SB19	Southwest corner of Bldg. 772	104'S, 462'E	45
SB20	Southwest corner of Bldg. 772	104'S, 559'E	45
SB21	Southwest corner of Bldg. 772	97'S, 767'E	45

5.11 Field Sampling Plan for Investigation Cluster (IC) 19 (Confirmed Sites [CS] 10, 11, 12, 13, and 14, the Fire Training Area, and the Contaminated Soils Holding Area)

Investigation Cluster 19 comprises Confirmed Sites 10, 11, 12, 13, and 14, the Fire Training Area, and the Contaminated Soils Holding Area (Figure 5.11-1). The IC is located in the northern portion of Operable Unit (OU) C. A site summary figure (5.11-2) schematically illustrates what is known about IC 19.

Confirmed Sites 10 through 14 are disposal pits that were used roughly from 1949 to 1974, reportedly for the disposal of ash and residues from waste that was incinerated elsewhere on McClellan Air Force Base (AFB) (CH2M HILL, 1993). It is possible that these pits received wastes from several locations on base. Table 5.11-1 summarizes the sizes of the pits and the contaminants found in them. In July 1993, the area of CSs 13 and 14 west of the road (Figure 5.11-1) was graded in preparation for construction of a contractor's staging area. Approximately 4 feet of soil were removed, and no evidence of contamination was observed.

A separate burn pit was used from 1977 to about 1987 for fire training exercises. The pit was located over and among CSs 11, 12, and 13. Fuel and oil were placed in the pit and ignited. A sump was supposed to have been installed between the pit and Building 1088 for collection of contaminated water and fire-suppression foam; however, it is not clear that the sump was ever actually constructed. Fire training activities currently take place north of CSs 10 through 14.

In 1987, a Contaminated Soils Holding Area was constructed over the Fire Training Area. The holding area was lined with 40-mil high density polyethylene (HDPE) over a clay base. The area is about 100 feet by 300 feet, fenced, and bermed. In July 1993, the HDPE liner was removed, and the area is scheduled to be paved. As the liner was removed, areas of stained soil were observed on the clay base.

At least two tanks are or were located in the area of the pits: one underground and one aboveground. The underground tank, located south of CS 10, was used to dispose of sewage from portable toilets; it was removed in August 1993. It apparently was not connected to any sanitary sewer line. The aboveground tank is located west of the dirt road that runs through CS 13; it was used to hold fuel — such as JP-4, diesel, and contaminated fuel — for the fires in the Fire Training Area.

The original Don Julio Creek (before it was channelized and lined) flows through the southeastern corner of IC 19. The creek is unlined and trends northeast to southwest. It carries water only seasonally, flowing to the oil/water separator in IC 16 and thence off base to the west. Historically, washwater contaminated with fuels and oils were discharged to the creek from the hush houses of Building 772 and 774 in IC 20.

Previous investigations of IC 19 are summarized in Table 5.11-2.

5.11.1 Data Quality Objectives

Data quality objectives for IC 19 are shown on Table 5.11-3.

5.11.2 Sampling Plan

Previous sampling locations are shown on Figure 5.11-3. Proposed sampling locations are shown on Figure 5.11-4. Cross sections of each site (Figures 5.11-5 through 5.11-9) were used to help determine sampling depths. The sampling and analytical matrix for IC 19 is shown in Table 5.11-4; field specifications for sampling locations are included in Table 5.11-5.

The first step in the investigation of IC 19 will be to survey the IC and place survey markers from which to measure sample locations. The area currently has few landmarks from which to measure sample locations.

Because of the likelihood of encountering methane gas caused by the degradation of organic material in IC 19, both a photoionization detector (PID) and flame ionization detector (FID) will be used, both for health and safety purposes and to screen vapors for sample collection. A lower explosive limit (LEL) meter will also be used. Adequate precautions will be taken during field activities to prevent combustion of the methane. These precautions are described in Appendix B to this SAP.

Rationale and specific objectives for sampling locations are outlined below.

Seven deep borings will be drilled to sample groundwater upgradient (Borings SB1, SB14, and SB22) and downgradient (Borings SB33 SB7, SB13, and SB27) of each of the disposal pits. (Two IC 21 borings, B2 and B3, will also be used to sample groundwater upgradient of the disposal pits in IC 19.) Samples will be analyzed for inorganic species and semivolatile and volatile organic compounds to determine if these compounds have migrated to groundwater from the pits. After results of the HydroPunch® samples are evaluated, two additional borings will be drilled downgradient of the disposal pits and monitoring wells will be installed. The locations of these wells will be discussed with team members from the Groundwater OU.

Magnetometer and electromagnetic surveys will be conducted at each pit prior to drilling at the location. If objects which may be buried drums are identified (see Section 4.4), then proposed borings in the area will not be drilled and trenches will be dug to locate the anomally and remove any buried drums. Soil samples will be collected as specified in Section 4.4. Standard operating procedures for digging trenches and removing drums are included in Appendix B to this report.

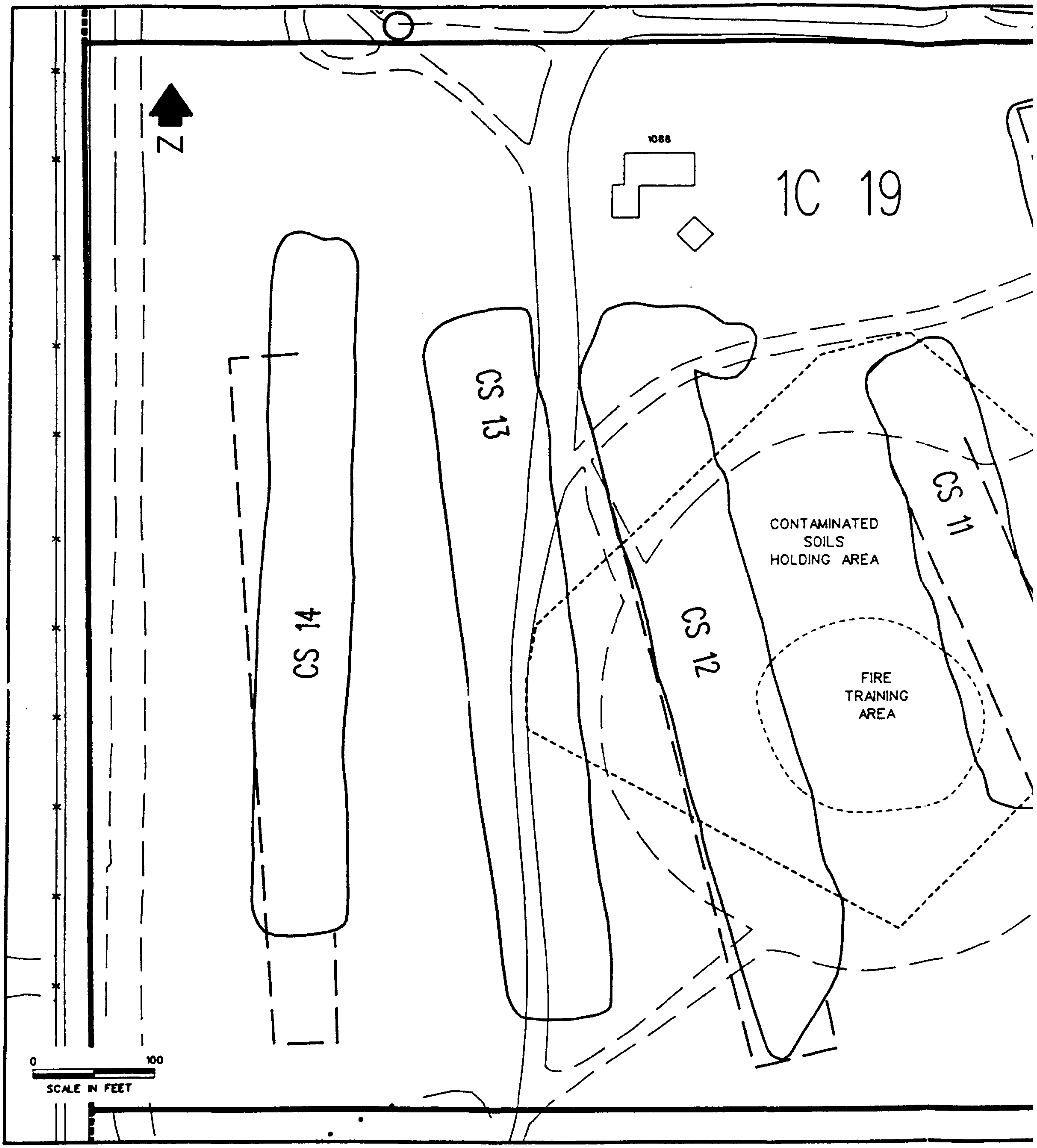
Four to six borings will be drilled to about 40 feet BGS through the center of each pit (Figure 5.11-3). Samples will be collected from within the waste materials to characterize the heterogeneous nature of the wastes, and to determine whether contaminants have migrated beneath the pits. Samples analyzed for organic compounds will be composited 4:1 over approximately 10-foot intervals in the waste to characterize the waste. Discrete samples will be collected from the native soils about 10 feet beneath the pits. The discrete sample yielding the highest concentration of inorganic constituents relative to the constituents toxicity will be analyzed for soluble metals (Section 4.3.2). Soil gas samples will be collected from within the pits and from the sandy layers beneath them. Boring depths may vary depending on the bottom of the waste and the decisions made with the boring decision diagram (Section 4.4). Borings drilled through the waste material will be cased to at least 10 feet below the waste.

Borings SB34 - SB37 will be located in the Fire Training Area and Contaminated Soils Holding Area. These borings are intended to determine whether contaminants from activities in those areas have contaminated the surface and subsurface, and to determine whether volatile contaminants are present in the soil gas. Samples will be collected to determine whether inorganic species, hydrocarbons, polycyclic aromatic hydrocarbons (PAHs), PCBs, or dioxins/furans are present in near-surface soils.

Hand auger HA1 will be drilled in the original Don Julio creekbed to determine whether fuels and oils disposed to the creek contaminated the sediments and the subsurface.

Surface scrape MC1 will be collected in the active Don Julio Creek west of CS 14 to determine whether the sediments in the creek are contaminated. The sample will be a 5:1 composite of creek sediments.

Physical parameter samples will be collected in four soil types in SB12 to provide information for vadose zone modeling and for evaluation of remedial action alternatives.



N
1088
1C 19
CS 14
CS 13
CS 12
CS 11
CONTAMINATED
SOILS
HOLDING AREA
FIRE
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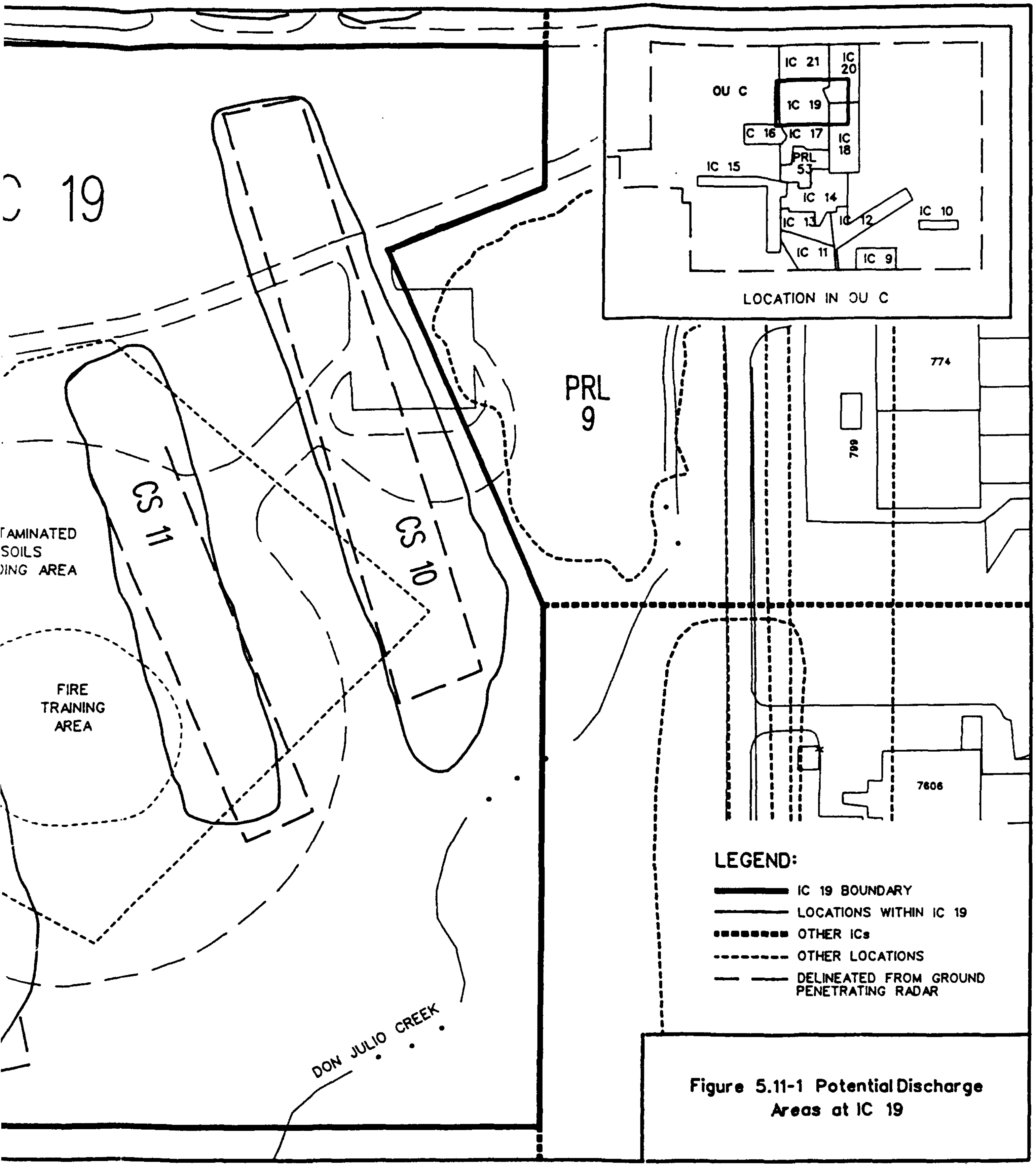


Figure 5.11-1 Potential Discharge Areas at IC 19

OUC1 IC19PDA SAC 9/14/93

CS14

CONTAMINANTS IN PIT MATERIAL

Compound	µg/kg
1,2-Dichlorobenzene	840
1,4-Dichlorobenzene	610
2-Butanone	120
2-Methylnapthalene	180
2,6-Dinitrotoluene	100
Acenapthene	210
Anthracene	150
Benzyl alcohol	100
Bis(2-Ethylhexyl)phthalate	11,000
Butylbenzylphthalate	370
Chlorobenzene	46
Dibenzofuran	230
Diethylphthalate	300
Dimethylphthalate	880
Di-N-Butylphthalate	1,300
Di-N-Octylphthalate	160
Diphenylamine	660
Fluoranthene	430
Fluorene	300
Naphthalene	220
Phenanthrene	1,300
Phenol	130
Pyrene	240
Styrene	23
Toluene	43
Total Xylenes	250
Metal (Total)	**mg/kg**
Antimony	310
Barium	330
Cadmium	49
Copper	400
Lead	970
Mercury	29
Thallium	61
Zinc	3,100
Oil & Grease	4,100

CS13

CONTAMINANTS IN PIT MATERIAL

Compound	µg/kg
1,2-Dichlorobenzene	380
1,4-Dichlorobenzene	120
2-Butanone	43,000
2-Hexanone	2,600
2-Methylnapthalene	250
2-Methylphenol	350
2,4-Dimethylphenol	400
2,6-Dinitrotoluene	1,700
4-Chloroaniline	270
4-Methylphenol	950
Acenapthene	100
Acetone	46,000
Benzoic acid	200
Bis(2-Ethylhexyl)phthalate	2,400
Chlorobenzene	22
Chlordane	720
Chrysene	170
Diethylphthalate	170
Di-N-Butylphthalate	420
Ethylbenzene	2,500
Fluoranthene	180
Naphthalene	310
N-Nitrosodi-N-propylamine	950
N-Nitrosodiphenylamine	22,000
PCB (Aroclor 1260)	1,800
Pentachlorophenol	340
Phenanthrene	190
Phenol	220
Pyrene	150
Styrene	15
Toluene	1,100
Total Xylenes	1,500
Trans-1,2-Dichloroethylene	98
Metal (Total)	**mg/kg**
Cadmium	51
Chromium	340
Copper	200
Lead	380
Oil & Grease	7,500

CS12

CONTAMINANTS IN PIT MATERIAL

Compound	µg/kg
1,1,1-Trichloroethane	10
1,2-Dichlorobenzene	2,800
1,4-Dichlorobenzene	1,400
2-Methylnapthalene	740
2,4-Dinitrotoluene	200
2,6-Dinitrotoluene	420
4-Methylphenol	280
4-Nitrophenol	3,300
Acenapthene	3,200
Acenaphthylene	310
Acetone	280
Anthracene	5,800
Benzo(a)anthracene	13,000
Benzo(g,h,i)perylene	4,100
Benzoic acid	380
Benzyl alcohol	150
Bis(2-Ethylhexyl)phthalate	10,000
Butylbenzylphthalate	740
Chlorobenzene	91
Chrysene	12,000
Dibenzo(a,h)anthracene	1,200
Dibenzofuran	3,500
Diethylphthalate	280
Dimethylphthalate	180
Di-N-Butylphthalate	3,400
Endosulfan I	40
Endosulfan sulfate	670
Ethylbenzene	250
Fluoranthene	28,000
Fluorene	5,400
Hexachlorethane	150
Ideno(1,2,3-cd)pyrene	4,800
Methylene chloride	210
Naphthalene	1,200
N-Nitrosodiphenylamine	110
PCE	14
Phenanthrene	34,000
Phenol	280
Styrene	13
Toluene	280
Total Xylenes	740
Metal (Total)	**mg/kg**
Antimony	210
Copper	1,200
Lead	620
Thallium	51
Zinc	2,700
Oil & Grease	10,500

CS11

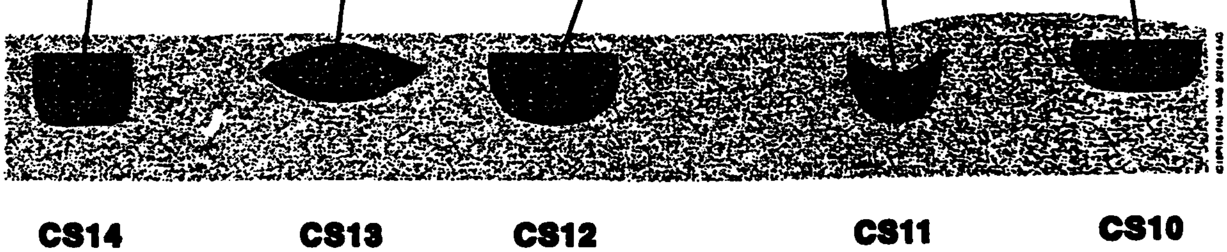
CONTAMINANTS IN PIT MATERIAL

Compound	µg/kg
1,2-Dichlorobenzene	8,000
1,2,4-Trichlorobenzene	270
1,3-Dichlorobenzene	1,900
1,4-Dichlorobenzene	4,200
2-Methylnapthalene	810
2-Methylphenol	870
2,4-Dimethylphenol	2,000
4-Methylphenol	1,200
Acetone	1,300
Benzoic acid	45,000
Benzyl alcohol	180
Bis(2-Ethylhexyl)phthalate	50,000
Butylbenzylphthalate	120
Chlorobenzene	380
Chloroform	140
Dibenzofuran	280
Diethylphthalate	140
Dimethylphthalate	340
Di-N-Butylphthalate	3,100
Diphenylamine	400
Endosulfan I	20
Ethylbenzene	480
Fluoranthene	2,800
Fluorene	240
Methylene chloride	280
Naphthalene	440
N-Nitrosodiphenylamine	400
Pentachlorophenol	470
Phenanthrene	370
Phenol	540
Pyrene	240
Toluene	120
Total Xylenes	72
Metal (Total)	**mg/kg**
Arsenic	27
Barium	400
Cadmium	49
Chromium	1,400
Copper	980
Lead	4,400
Mercury	15
Thallium	61
Zinc	4,000
Oil & Grease	8,100

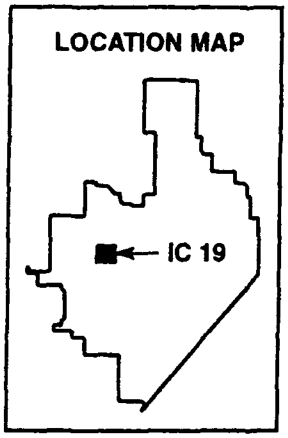
CS10

CONTAMINANTS IN PIT MATERIAL

Compound	µg/kg
1,2-Dichlorobenzene	430
1,3-Dichlorobenzene	110
2-Hexanone	30
2-Methylnapthalene	140
2,6-Dinitrotoluene	650
4-Methyl-2-pentanone	160
Acenapthalene	140
Anthracene	110
Benzyl alcohol	340
Bis(2-Ethylhexyl) phthalate	12,000
Chlorobenzene	32
Chloroform	880
Chrysene	400
Diethylphthalate	470
Dimethylphthalate	240
Di-N-Butylphthalate	1,400
Fluoranthene	380
Fluorene	230
Methylene chloride	110
Naphthalene	210
PCB (Aroclor 1260)	150,000
Pentachlorophenol	1,800
Phenanthrene	500
Phenol	370
Pyrene	930
TCE	33
Toluene	160
Total Xylenes	22
Metal (Total)	**mg/kg**
Antimony	330
Cadmium	150
Chromium	350
Copper	5,800
Lead	1,300
Nickel	280
Silver	80
Thallium	61
Zinc	7,900
Oil & Grease	34,500



Contaminants in Pit Material
(See Figure 5.11-2 for additional information)



CS 14 CS 13 CS 12

CONTAMINANTS IN NEAR SURFACE SOIL GAS (CS 14)

Compound	ppbv
Carbon tetrachloride	0.1
Chloroform	40
Methyl chloroform	4
Methylene chloride	100
PCE	10
TCE	2

CONTAMINANTS IN NEAR SURFACE SOIL GAS (CS 13)

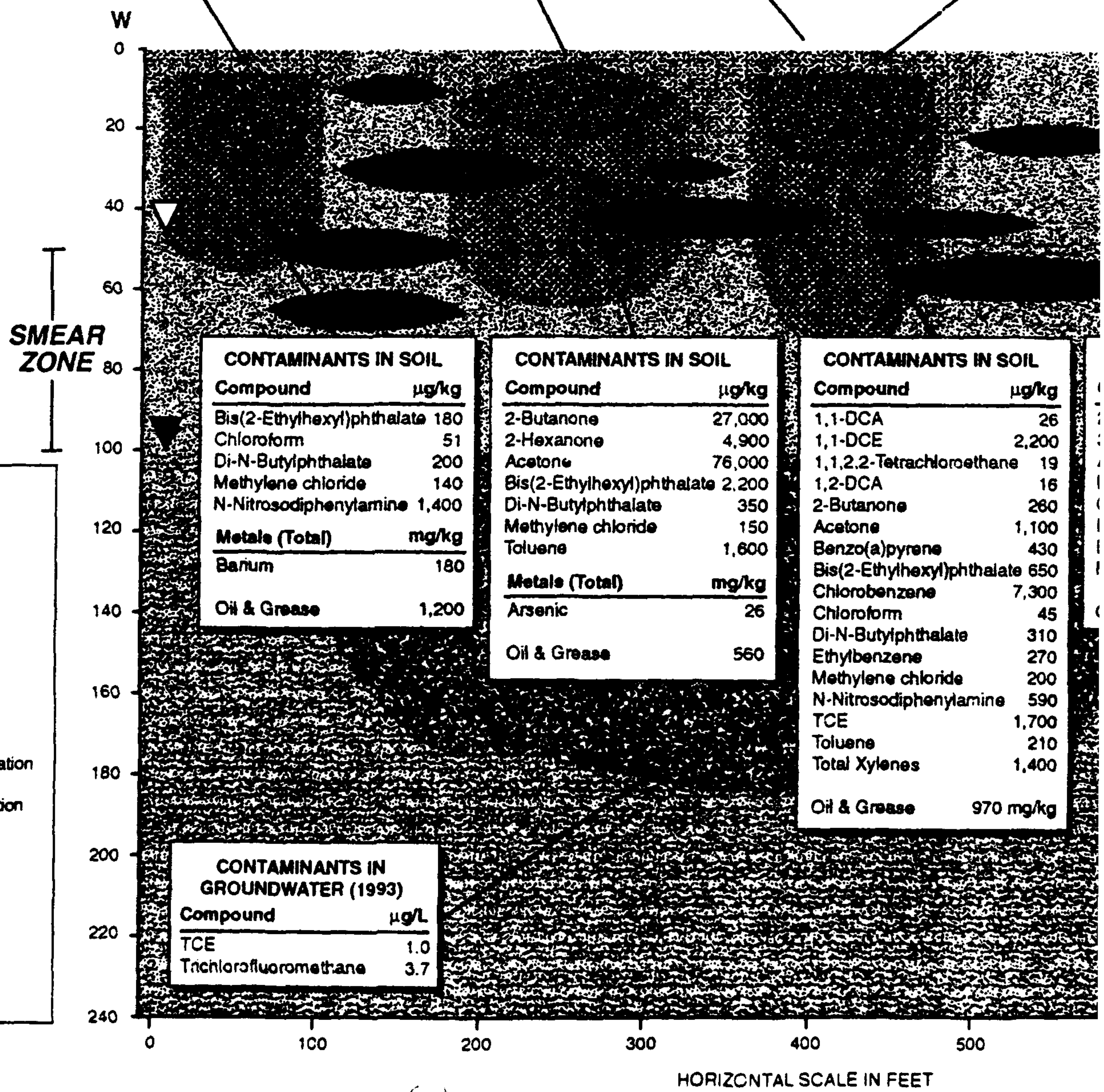
Compound	ppbv
Benzene	600
Methyl chloroform	4
Methylene chloride	200
PCE	6
TCE	40
Vinyl chloride	5,000
Methane	7.4%

CONTAMINANTS IN AIR (FLUX MEASUREMENTS)

Compound	ppbv
1,1,1-TCA	0.37
Carbon tetrachloride	0.14
Methylene chloride	0.75
PCE	0.41
Methane	2,500

CONTAMINAN NEAR SURFACE S (CS 12)

Compound	
Benzene	
Carbon tetrachloride	
Chloroform	
Methyl chloroform	
Methylene chloride	
PCE	
TCE	
Vinyl chloride	
Methane	



CONTAMINANTS IN SOIL (CS 14)

Compound	µg/kg
Bis(2-Ethylhexyl)phthalate	180
Chloroform	51
Di-N-Butylphthalate	200
Methylene chloride	140
N-Nitrosodiphenylamine	1,400
Metals (Total)	**mg/kg**
Barium	180
Oil & Grease	1,200

CONTAMINANTS IN SOIL (CS 13)

Compound	µg/kg
2-Butanone	27,000
2-Hexanone	4,900
Acetone	76,000
Bis(2-Ethylhexyl)phthalate	2,200
Di-N-Butylphthalate	350
Methylene chloride	150
Toluene	1,600
Metals (Total)	**mg/kg**
Arsenic	26
Oil & Grease	560

CONTAMINANTS IN SOIL (CS 12)

Compound	µg/kg
1,1-DCA	26
1,1-DCE	2,200
1,1,2,2-Tetrachloroethane	19
1,2-DCA	16
2-Butanone	260
Acetone	1,100
Benzo(a)pyrene	430
Bis(2-Ethylhexyl)phthalate	650
Chlorobenzene	7,300
Chloroform	45
Di-N-Butylphthalate	310
Ethylbenzene	270
Methylene chloride	200
N-Nitrosodiphenylamine	590
TCE	1,700
Toluene	210
Total Xylenes	1,400
Oil & Grease	970 mg/kg

CONTAMINANTS IN GROUNDWATER (1993)

Compound	µg/L
TCE	1.0
Trichlorofluoromethane	3.7

KEY

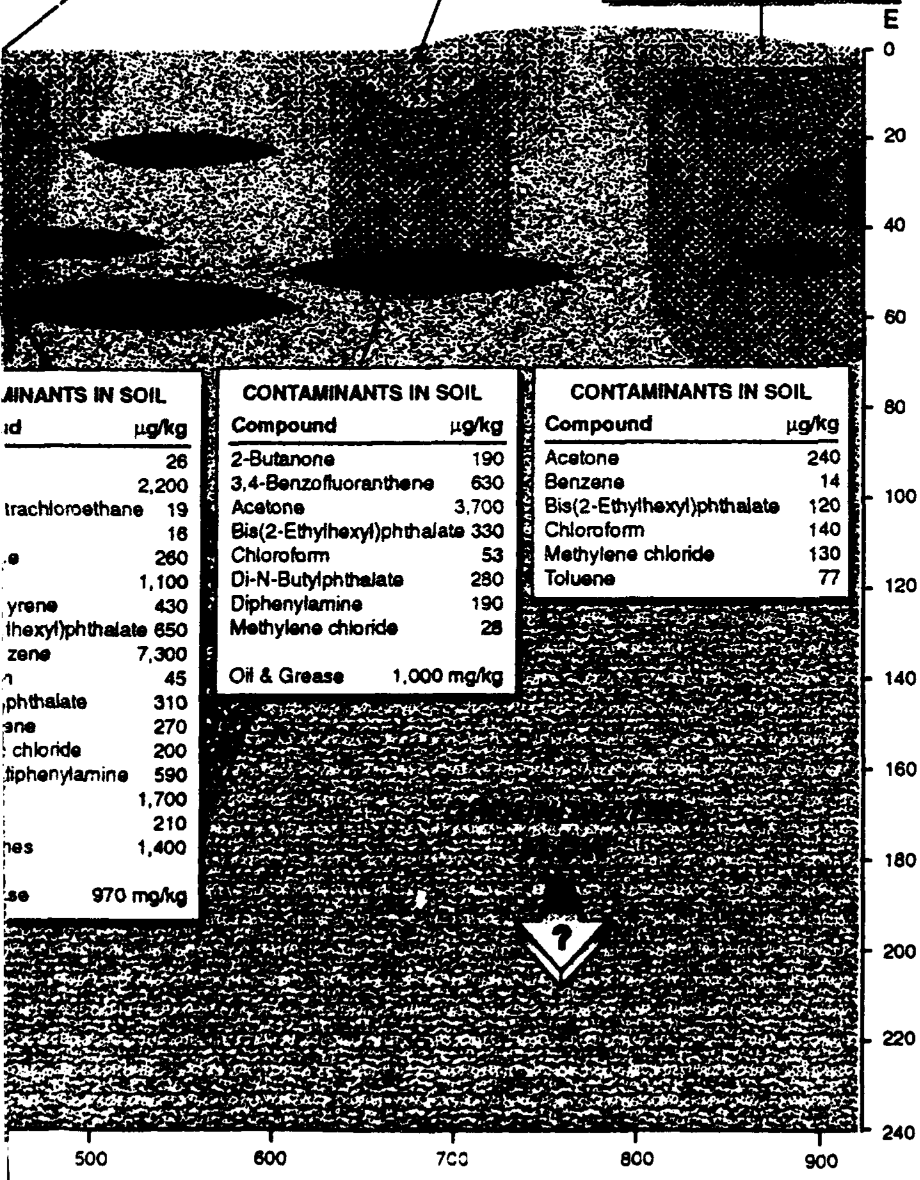
- Current Water Table
- Former Water Table
- Sand/Silt
- Clay/Hardpan
- Pit Material
- Dissolved Contamination
- Soil Gas Contamination
- Soil Contamination

Tables show maximum concentrations detected in medium for each site

Groundwater data are the most recent available

(1)

2 CS 11 CS 10



CONTAMINANTS IN NEAR SURFACE SOIL GAS

Compound	ppbv
Benzene	32,000
Carbon tetrachloride	60
Chloroform	2,000
Methyl chloroform	80
Methylene chloride	1,000
PCE	4,000
TCE	8,000
Vinyl chloride	56,000
Methane	4.5%

CONTAMINANTS IN NEAR SURFACE SOIL GAS

Compound	ppbv
Methyl chloroform	0.6
PCE	3
TCE	4
Methane	2.6%

CONTAMINANTS IN NEAR SURFACE SOIL GAS

Compound	ppbv
Carbon tetrachloride	0.1
Methyl chloroform	0.4
TCE	0.4

...INANTS IN SOIL

...d	µg/kg
	26
	2,200
...trachloroethane	19
	16
...e	260
	1,100
...yrene	430
...hexyl)phthalate	650
...zene	7,300
...n	45
...phthalate	310
...ane	270
... chloride	200
...diphenylamine	590
	1,700
	210
...hes	1,400
...se	970 mg/kg

CONTAMINANTS IN SOIL

Compound	µg/kg
2-Butanone	190
3,4-Benzofluoranthene	630
Acetone	3,700
Bis(2-Ethylhexyl)phthalate	330
Chloroform	53
Di-N-Butylphthalate	280
Diphenylamine	190
Methylene chloride	28
Oil & Grease	1,000 mg/kg

CONTAMINANTS IN SOIL

Compound	µg/kg
Acetone	240
Benzene	14
Bis(2-Ethylhexyl)phthalate	120
Chloroform	140
Methylene chloride	130
Toluene	77

Site Status:
-- PA/SIs complete

Source Areas:
-- Pits in CS 10 - CS 14

Groundwater Impacts:
-- Potential for contaminant migration will be evaluated during the RI

Completed Evaluated Pathways:
-- Air pathway from flux of VOCs to atmosphere

Evaluated Risks:
-- Health risks will be evaluated during the RI

ARARs Evaluation:
-- ARARs evaluation will be completed during the RI

Uncertainties:
-- Whether DNAPLs are present
-- Whether sites are contributing to groundwater contamination
-- Northern and southern boundaries of CS 10, CS 12, CS 13, CS 14
-- Presence of solid objects
-- Presence of methane gas
-- Groundwater flow and quality

Volume/Mass Estimates:
-- Estimated volume of pit material:
CS 10 = 20,415 yd^3
CS 11 = 6,840 yd^3
CS 12 = 23,590 yd^3
CS 13 = 8,310 yd^3
CS 14 = 21,470 yd^3
-- Mass will be calculated during RI

Recommendations:
-- Perform Phase I RI
-- Determine if contaminants in the pits are contributing to groundwater contamination
-- Determine groundwater flow and quality
-- Determine contaminant concentrations in soil gas
-- Determine mass of contamination

Revision dates:

Figure 5.11-2.
Site Summary Figure for IC 19

IC19.FH3 - VMG 2/25/94 SAC

(2)

TABLE 5.11-1. SIZE OF PITS AND TYPES OF WASTES IN IC 19[a]

Site	Approximate Years of Operation	Average Width (ft)	Average Length (ft)	Average Thickness of Fill Above Waste (ft)	Estimated Volume of Pit Material (in yd^3)		Type of Material in Waste
					Debris	Fill	
CS 10	1949–1957	100	530	5	20,415	9,815	Concrete, asphalt, debris, metal, glass, wood, plastic, ceramic, rubber, other blackened material.
CS 11	1965	80	405	10.8	6,840	12,960	Burned debris, wood, metal, plastic, paper, oily appearance
CS 12	1965–1970	90	610	7	23,590	14,200	Burned debris, wood, metal, glass, plastic, plexiglass, sludge
CS 13	1969–1971	87	600	8.2	8,310	15,850	Metal, wood, plastic, rubber, paper, glass, sludge, carbonaceous material
CS 14	1971–1974	70	600	8.2	21,470	12,760	Metal, glass, wood, cloth, paper, plastic, organic debris, black runny material
Fire Training Area	1977–1982	250[b]	—	NA	NA	NA	Fuel and oils

[a] Source: CH2M HILL, 1993.
[b] Diameter of circular pit.

TABLE 5.11-2. PREVIOUS INVESTIGATIONS AT IC 19

Year, Contractor	Scope of Investigation	Key Findings
1985, McLaren Environmental Engineers	Investigation of potential contamination at CSs 10 through 14. Ground-penetrating radar surveys were conducted at all five sites, and a total of 64 borings were drilled.	Samples were analyzed for VOCs, SVOCs, PCBs, pesticides, and metals. VOCs, SVOCs, PAHs, oil and grease, pesticides, and inorganic species above subsurface background were detected in both composited and discrete waste samples from all five sites. PCBs were detected in samples from CSs 10 and 13; one sample from CS 12 contained dibenzofuran.
1987, Radian Corporation	Landfill gas sampling conducted as part of Phase 1 SWAT. Seventeen soil gas probes were driven to depths between 2 and 8 feet BGS.	VOCs (including vinyl chloride) was detected in samples from all five locations. Concentrations ranged from less than 1 ppbv to 56,000 ppbv from CS 12. Methane gas detected at percent level in samples from CSs 11, 12, and 13.
1989, Radian Corporation	Basewide investigation of stream water and sediments for potential organic and metal contamination.	Sediment samples collected from creeks that flow past CSs 10 and 13 contained phenol and oil and grease. However, these results cannot definitively be associated with IC 19.
1989, Radian Corporation	Basewide investigation of surface soil vapor for potential organic contamination. The five sites in IC 19 were investigated together.	Maximum HNu® results were 100 ppmv; maximum OVA results were 205 ppmv. Both high results were in the CS 12 area; however, both were near the Contaminated Soils Holding Area.
1992, CH2M HILL	Phase II SWAT included collecting 12 surface emission samples at CS 12.	Very low levels of TCE, PCE, methylene chloride, and carbon tetrachloride were detected, as well as methane at about 2,000 ppbv.
1993, CH2M HILL	Preliminary Assessment of sites and locations in OU C.	Identified areas to be investigated in OU C through records review, site visits, and interviews with base personnel.
Ongoing, Radian Corporation	Groundwater Sampling and Analysis Program to determine groundwater contaminant concentrations.	Concentrations of TCE, cis-1,2-DCE, and 1,1-DCE have been consistently reported in samples from MW-44S and MW-62, which are 1,000 feet and 500 feet, respectively, south (downgradient) of the sites in IC 19.

NOTE: Acronyms are defined in the acronym list at the beginning of this SAP.

TABLE 5.11-3. DATA QUALITY OBJECTIVES FOR SOIL AND SOIL GAS AT CSs 10 THROUGH 14

Problem Statement

Industrial sludges, hazardous waste, or other wastes disposed to the pits may have contaminated the subsurface.

Decision to be Made

- Determine if contaminants from the pits have migrated to the subsurface.
- Determine the location priority.

Inputs to the Decision

Level II/III data for soil gas; organic and inorganic constituents in soil.

Boundaries of the Study

Soil gas samples from about 20 to about 100 feet BGS; waste samples from within the landfill wastes; soil samples from about 1 to about 40 feet BGS collected in and beneath the pits; and groundwater samples collected north (upgradient?) and south (downgradient?) of each pit.

Decision Rules

- If organic contaminants are reported in the soil beneath the waste material, then contaminants have migrated from the landfill.
- If inorganic species are reported above subsurface background concentrations in soil samples, then inorganic contaminants may have migrated from the landfill, and the decision process for inorganic species should be applied.
- If VOCs are reported in the soil gas and if concentrations are greater than adjacent or surrounding borings, the contamination may have originated at this location.
- If all data collected are validated, proceed to Data Evaluation DQOs (see Section 4.2.2).

Limits on Uncertainty

Analytical data must meet project specifications for precision and accuracy.

Sample Design

Soil gas samples collected in borings SB1, SB7, SB13, SB14, SB22, SB27, and SB33 will help determine whether VOCs in the soil gas have migrated laterally from the pits. Borings SB2-SB6, SB8-SB12, SB15-SB20, SB23-SB26, and SB28-SB32 will be drilled approximately 100 feet apart through the disposal pits. Samples will be collected from within the waste material to determine their contents, and approximately 10 feet beneath the bottom of the pits to determine if contaminants in the pits have migrated vertically.

TABLE 5.11-3. (Continued)

DATA QUALITY OBJECTIVES FOR GROUNDWATER BENEATH IC 19

Problem Statement

Groundwater quality upgradient and downgradient of the pits is unknown. Contaminants from the pits may have migrated to groundwater.

Decision to be Made

- Determine groundwater flow directions.
- Determine if the groundwater beneath the location is contaminated.
- Determine the location priority.

Inputs to the Decision

Level III data for groundwater. Previous groundwater flow and contaminant data.

Boundaries of the Study

Groundwater samples from the A monitoring zone.

Decision Rules

- Contaminants from the location have contaminated the groundwater if all of the following are true:
  - Organic compounds or inorganic species above background are reported in groundwater samples downgradient of the location,
  - Those suites of compounds or species are also reported in soil gas or soil beneath the location, and
  - Those compounds or species are not reported at lower concentrations in upgradient samples.
- If all data collected are validated, proceed to Data Evaluation DQOs (see Section 4.2.2).

Limits on Uncertainty

Analytical data must meet project specifications for precision and accuracy.

Sample Design

Borings SB1, SB7, SB13, SB14, SB22, SB27, and SB33 will be drilled to groundwater upgradient and downgradient of the pits. Two monitoring wells will be installed at locations to be determined based on HydroPunch® results from these borings and from borings SB2 and SB3 in IC 21.

(Continued)

TABLE 5.11-3. (Continued)

DATA QUALITY OBJECTIVES FOR THE FIRE TRAINING AREA

Problem Statement Fuels, oils, and fire suppression materials used in fire training activities may have contaminated the surface and subsurface.
Decision to be Made • Determine if compounds used in the Fire Training Area have contaminated the surface. • Determine the location priority.
Inputs to the Decision Level II/III data for soil gas; Level III for organic and inorganic constituents in soil.
Boundaries of the Study Soil gas samples from approximately 20 feet BGS; soil samples from 1 foot to about 20 feet BGS.
Decision Rules • If organic contaminants are reported in soil samples, then the soil has been contaminated. • If inorganic species are reported above background concentrations in soil samples, then the soil may be contaminated and the decision process for inorganic species should be applied. • If VOCs are reported in the soil gas and if concentrations are greater than adjacent or surrounding borings, the contamination has originated at the Fire Training Area. • If all data collected are validated, proceed to Data Evaluation DQOs (see Section 4.2.2).
Limits on Uncertainty Analytical data must meet project specifications for precision and accuracy.
Sample Design Borings SB35–SB37 will be drilled about 100 feet apart in the center of the Fire Training Area. Boring SB34 will be drilled in the area where fire trucks were driven (boring is also in the contaminated Soils Holding Area).

(Continued)

TABLE 5.11-3. (Continued)

DATA QUALITY OBJECTIVES FOR THE CONTAMINATED SOILS HOLDING AREA

Problem Statement

Contaminants in the soil at the Soils Holding Area may have contaminated the surface and subsurface.

Decision to be Made

- Determine if contaminants from the Soils Holding Area have contaminated the surface.
- Determine if contaminants from the Soils Holding Area have contaminated the subsurface.
- Determine the location priority.

Inputs to the Decision

Level III for organic and inorganic constituents in soil; Level II/III for soil gas.

Boundaries of the Study

Soil samples from 1 to 5 feet BGS; soil gas samples from 20 to 40 feet BGS.

Decision Rules

- If organic contaminants are reported in surface or near-surface (< 6 feet BGS) soil, then the soil has been contaminated.
- If inorganic species are reported above subsurface background concentrations in soil samples, then the soil may be contaminated and the decision process for inorganic species should be applied.
- If VOCs are reported in the soil gas and if concentrations are greater than adjacent or surrounding borings, the contamination may have originated at this location.
- If all data collected are validated, proceed to Data Evaluation DQCs (see Section 4.2.2).

Limits on Uncertainty

Analytical data must meet project specifications for precision and accuracy.

Sample Design

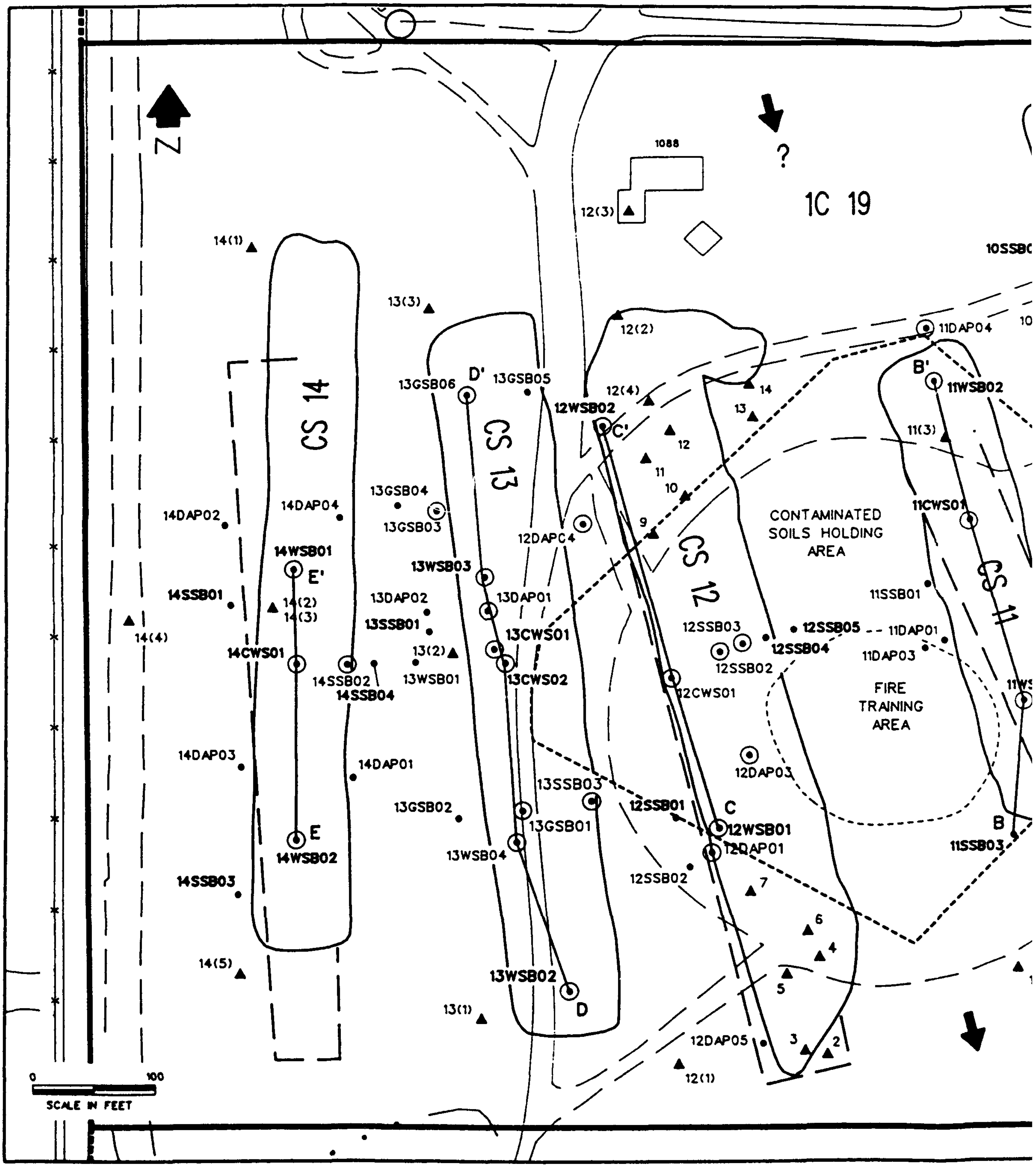
Borings SB34–SB37 will be placed in the contaminated Soils Holding Area.

(Continued)

TABLE 5.11-3. (Continued)

DATA QUALITY OBJECTIVES FOR THE CREEK/DRAINAGES IN IC 19

Problem Statement Contaminants in the creek/drainages may have contaminated the sediments and the subsurface.
Decision to be Made • Determine if organic or inorganic species have entered the creek sediments. • Determine the location priority.
Inputs to the Decision Level III data for organic and inorganic species in soil.
Boundaries of the Study Soil samples will be collected from the creekbed to 5 feet below the bed.
Decision Rule • If organic species are reported, sediments or soil are contaminated. • If inorganic species are reported above background concentrations, the sediments may be contaminated and the decision process for inorganic species should be applied. • If all data collected are validated, then apply Data Evaluation DQOs (see Section 4.2.2).
Limits on Uncertainty Analytical data must meet project specifications for precision and accuracy.
Sample Design Hand auger HA1 will be placed in the original Don Julio drainage. Surface scrape MC1 will be placed in the channelized and lined portion of Don Julio Creek west of CS 14. Surface samples from both locations will be 5:1 composites of creek sediments.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10SSB
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13DAP01
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12CWS01
FIRE TRAINING AREA
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13GSB02
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C
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B
14WSB02
13WSB04
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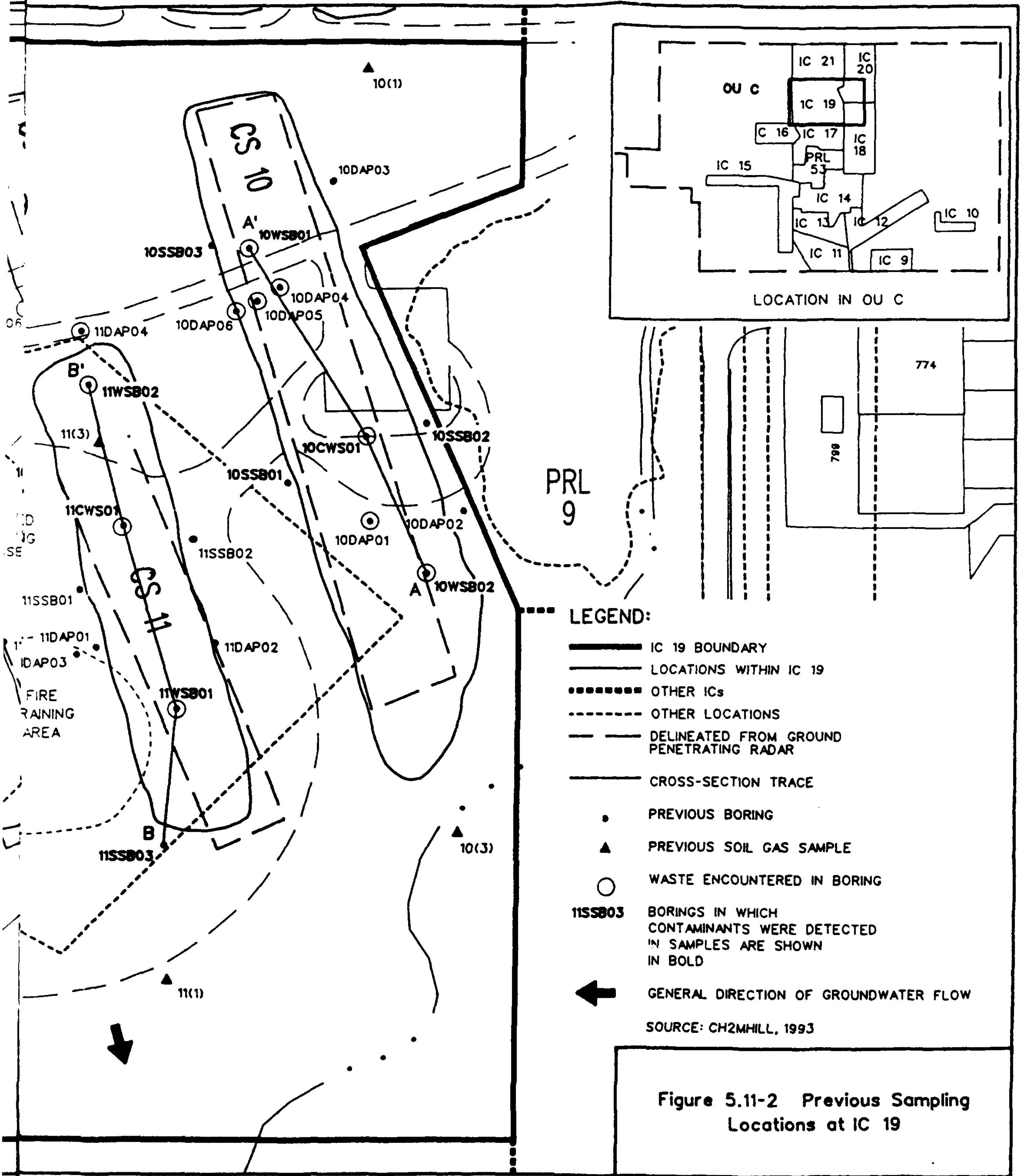

Figure 5.11-2 Previous Sampling Locations at IC 19

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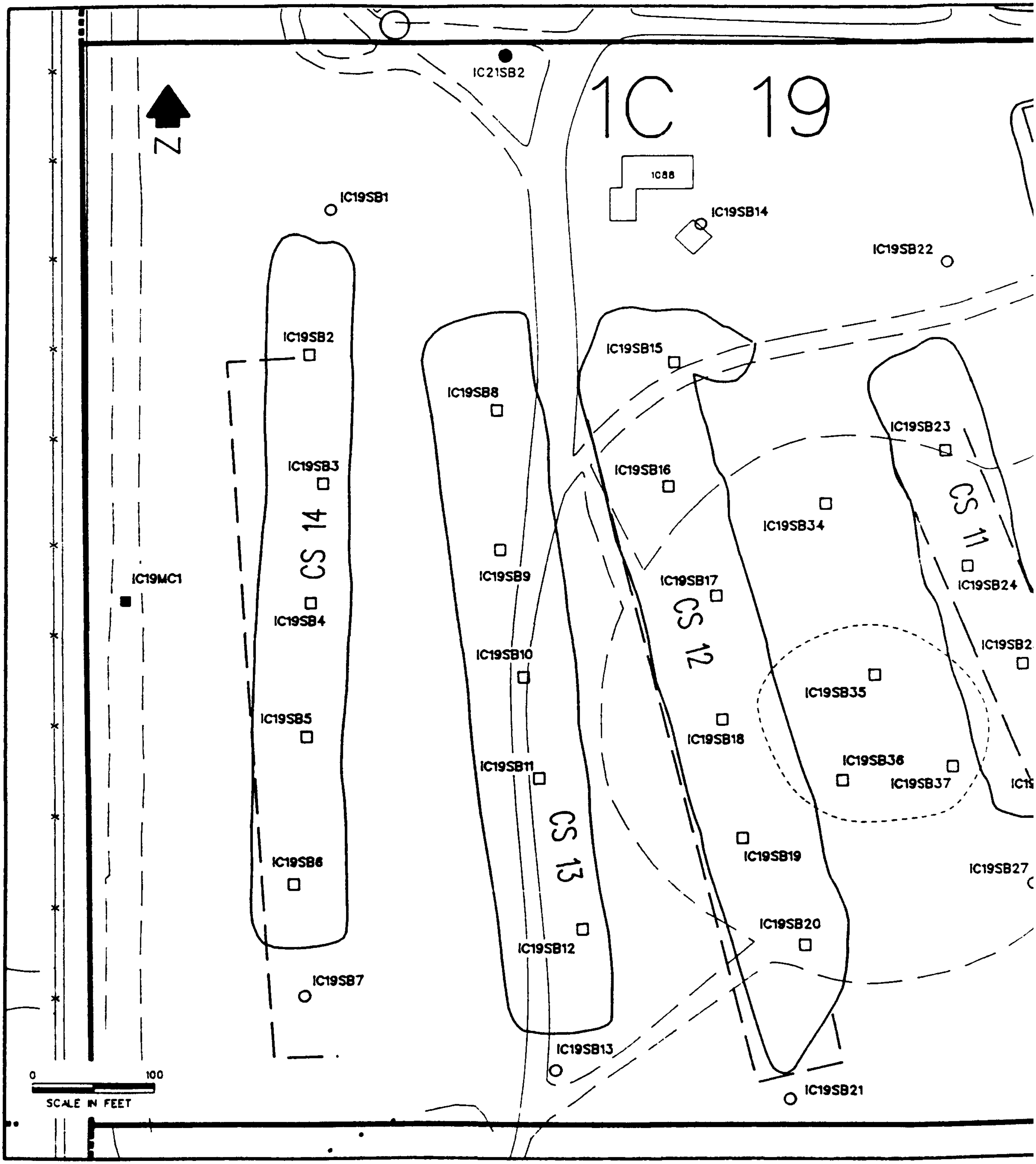

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IC19SB9
IC19SB10
IC19SB11
IC19SB12
IC19SB13
IC19SB14
IC19SB15
IC19SB16
IC19SB17
IC19SB18
IC19SB19
IC19SB20
IC19SB21
IC19SB22
IC19SB23
IC19SB24
IC19SB27
IC19SB34
IC19SB35
IC19SB36
IC19SB37
IC19MC1
CS 11
CS 12
CS 13
CS 14
0
100
SCALE IN FEET

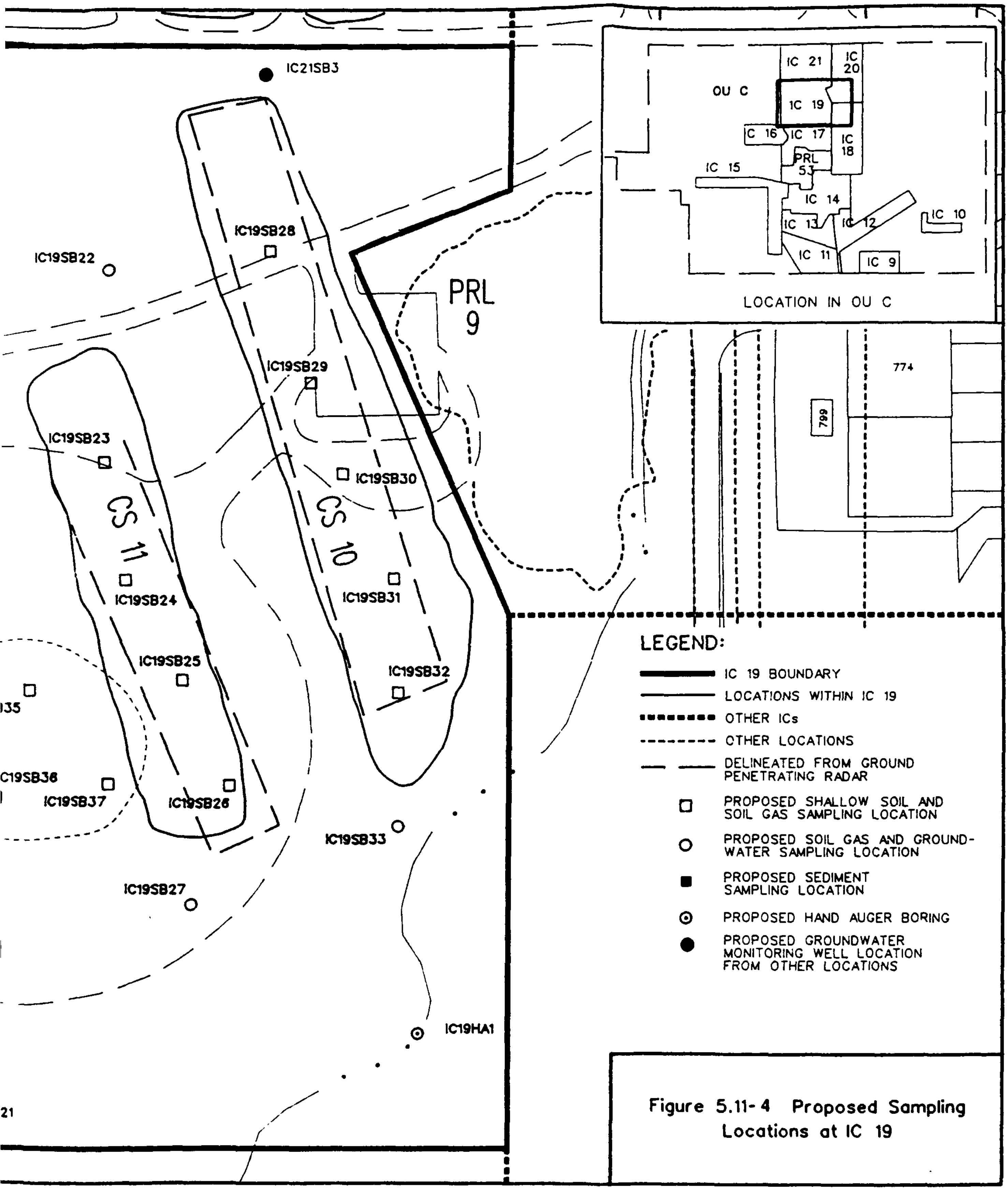
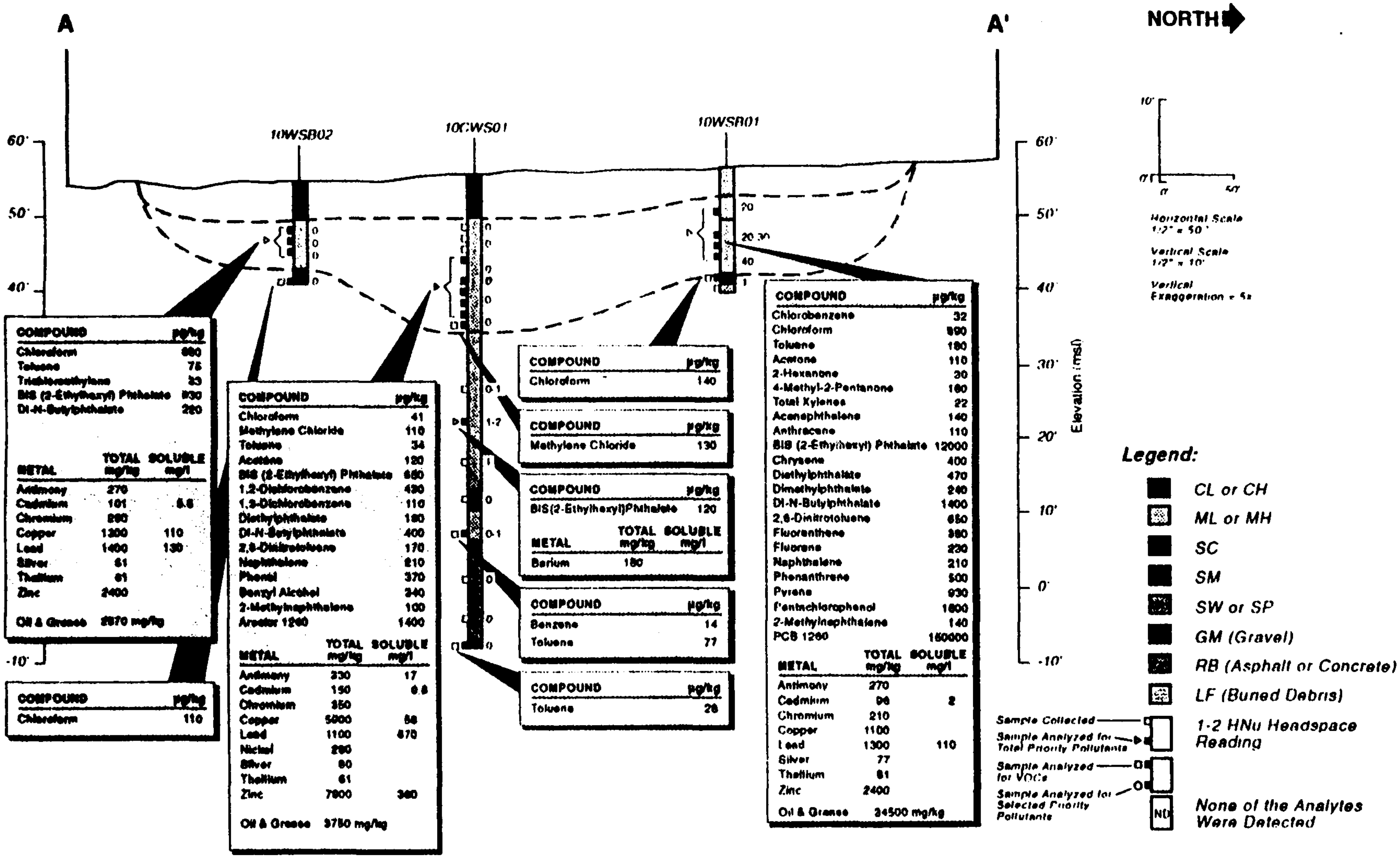


Figure 5.11-4 Proposed Sampling Locations at IC 19

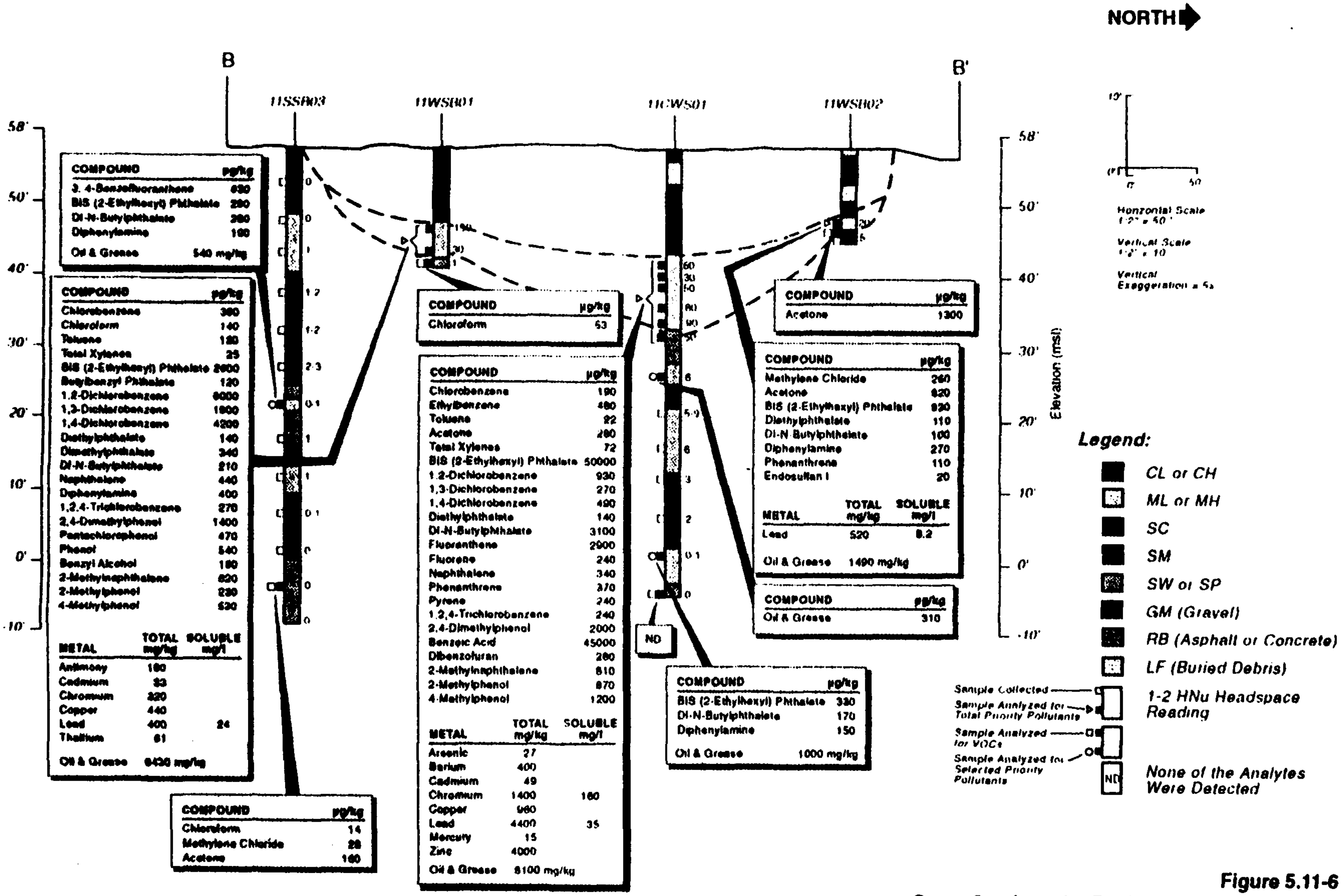
OUC4 IC19PSL SAC 2/22/94

2



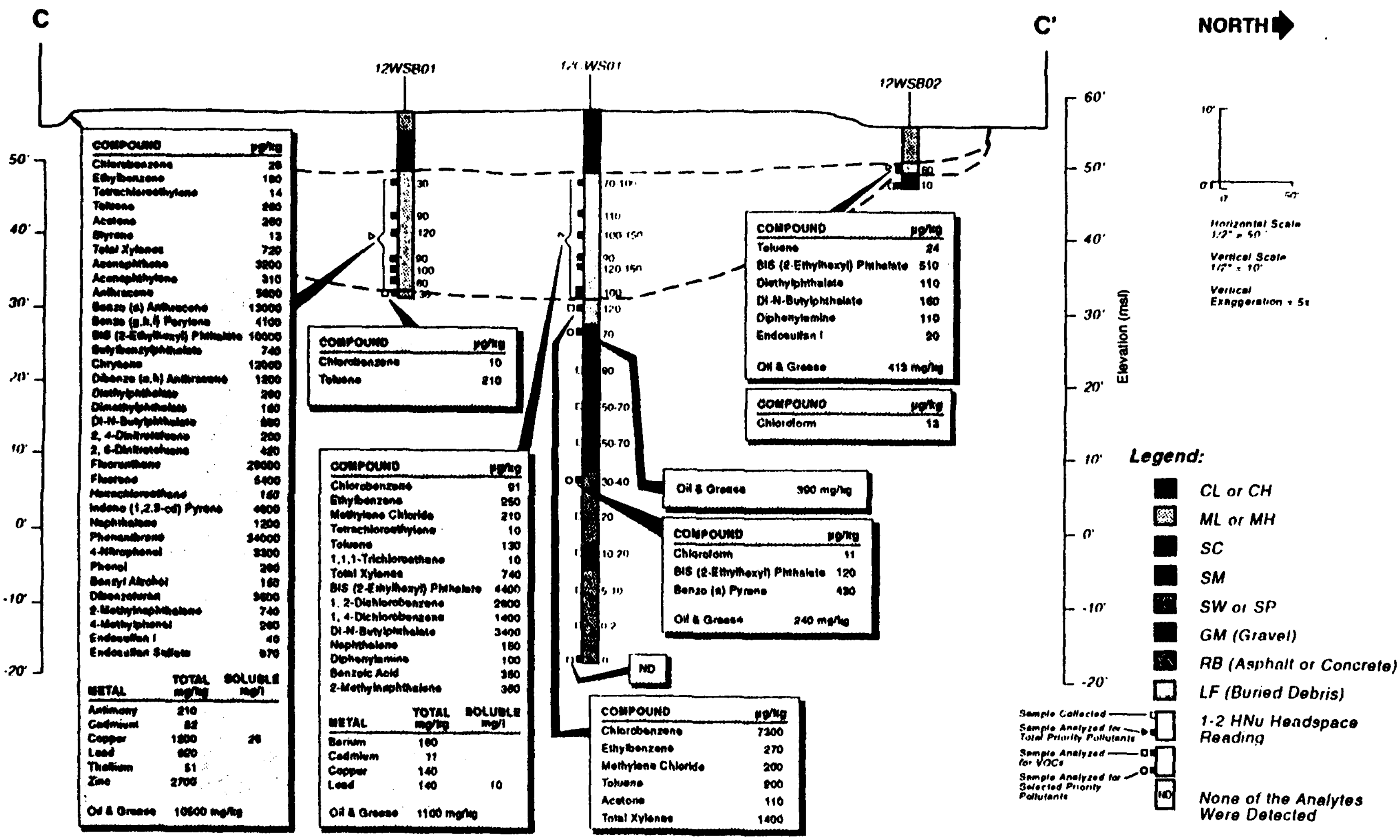
Source: McLaren Environmental Engineering
OUCX8.FH3 · VMG 2/21/94 SAC

Figure 5.11-5.
Cross Section with Positive Analytical Results
CS 10: Burial Pits



Source: *McLaren Environmental Engineering*
OUCX1.FH3 · VMG 2/21/94 SAC

Figure 5.11-6
Cross Section with Positive Analytical Results
CS 11: Burial Pits



Source: McLaren Environmental Engineering
OUCX2.FH3 - VMG 2/21/94 SAC

Figure 5.11-7
Cross Section with Positive Analytical Results
CS 12: Burial Pits

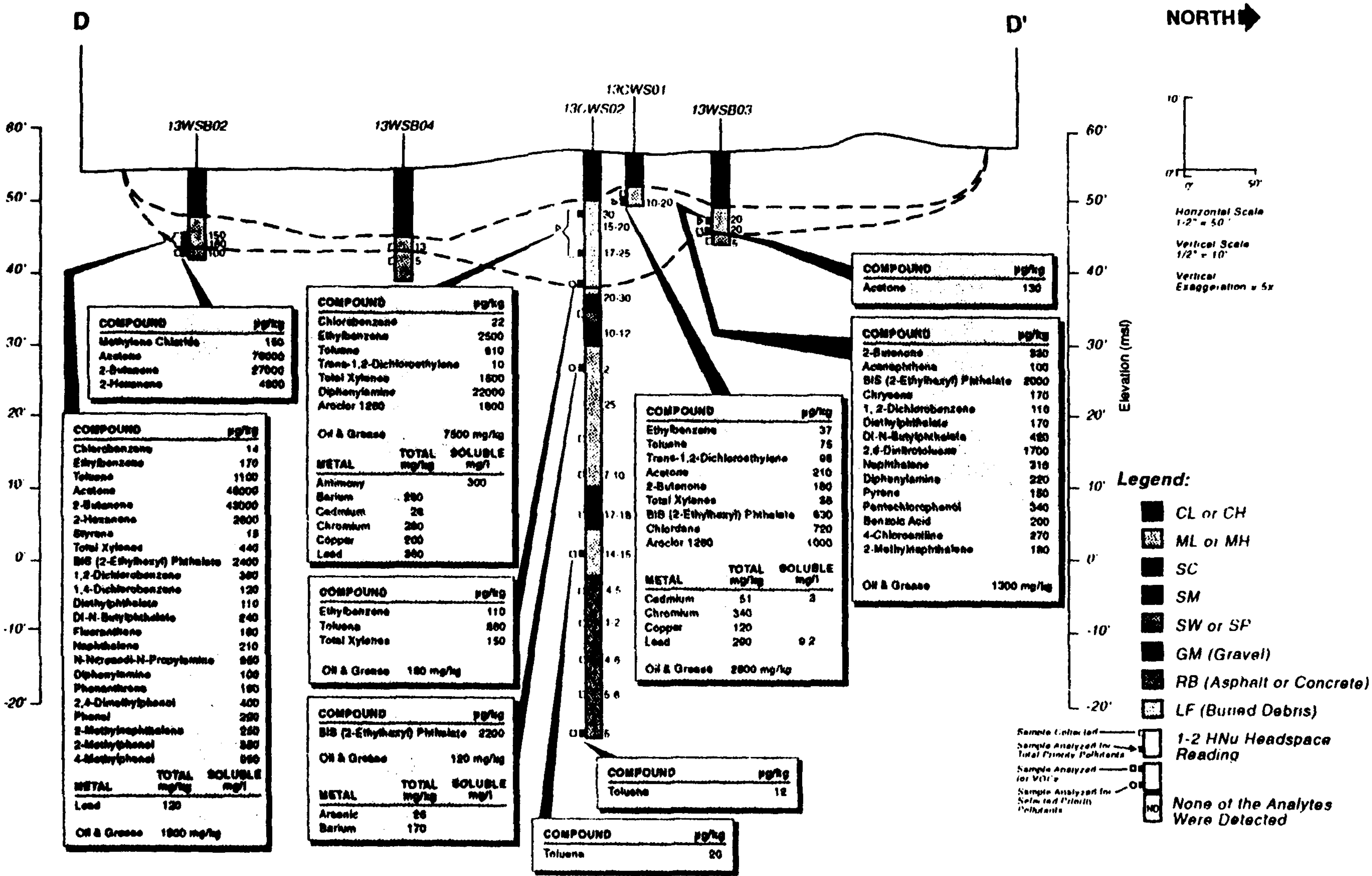
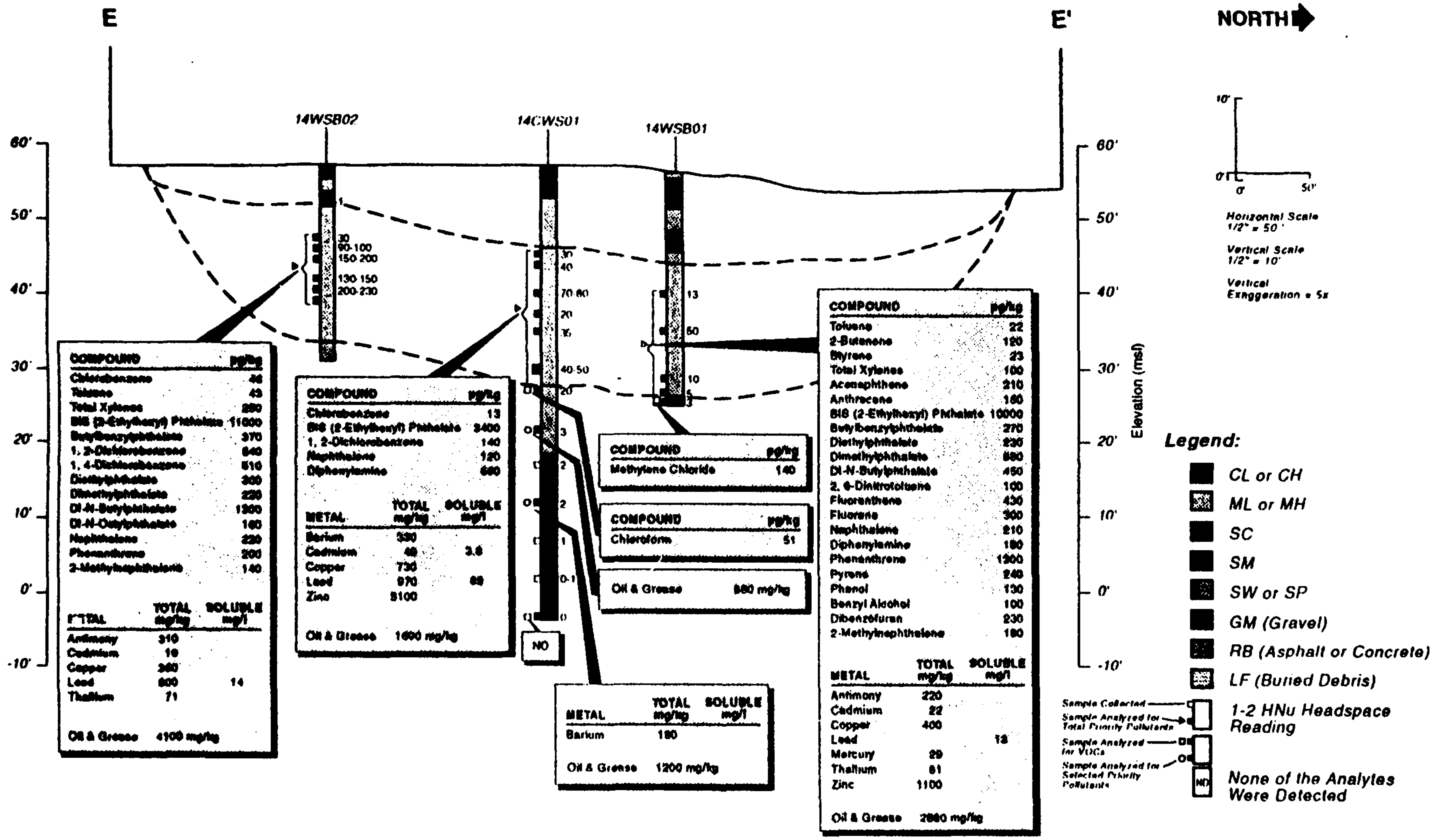


Figure 5.11-8
Cross Section with Positive Analytical Results



Source: McLaren Environmental Engineering
OUCX4.FH3 - VMG 2/21/94 SAC

Figure 5.11-9
Cross Section with Positive Analytical Results
CS 14: Burial Pits

TABLE 5.11-4. SAMPLING AND ANALYTICAL MATRIX FOR IC 19

Location:	CS 10 — Burial Pit		CS 11 — Burial Pit		
Potential Contaminants of Concern:	VOCs, SVOCs, PCBs, PAHs, Dioxins/furans, Petroleum hydrocarbons, Inorganics species, Cyanide, Acids, Bases		VOCs, SVOCs, PAHs, PCBs, Dioxins/furans, TPH, Inorganic species, Cyanide, Acids, Bases		
Sampling Location:	Borings SB28-SB32	Boring SB33	Boring SB24	Borings SB23, SB25, SB26	Borings SB22, SB27
Sample Depth and Analytical Method:	(10-20' in waste) ModSW8015/3550[a], SW8270[a], SW8080[a], SW8280[a], SW9012[a], SW9045[a], SW6010, SW7060, SW7471, SW7740, ModSW8015/5030, E218.6[b], SW8310[a] (15-25') FGC (25')[f] ModSW8015/3550, ModSW8015/5030, SW8270, SW8080, SW8280, SW9012, SW9045, SW6010, SW7060, SW7471, SW7740, SW8310, SW1311/SW6010[j], SW1311/SW7060[j], SW1311/SW7471[j], SW1311/SW7740[j] (35-45') FGC	(15-25') FGC (35-45') FGC (55-65') FGC (75-85') FGC (90-100') FGC (groundwater) SW8260[c,i], SW6010D, SW8270, SW7060D, SW7421D, SW7740D, SW7470D	(1') SW6010, ModSW8015/3550, SW8310, SW8270, SW8080, SW8280 (5') ModSW8015/3550, ModSW8015/5030, SW8310, SW8270, SW8080, SW8280 (15-25') FGC, TO-14 (15-25' in waste) ModSW8015/3550[a], SW8270[a], SW8080[a], SW8280[a], SW9012[a], SW9045[a], SW6010, SW7060, SW7471, SW7740, ModSW8015/5030, E218.6, SW8310[a] (35') ModSW8015/3550, ModSW8015/5030, SW8270, SW8080, SW8280, SW9012, SW9045, SW6010, SW7060, SW7471, SW7740, SW8310, E218.6, SW1311/SW6010[j], SW1311/SW7060[j], SW1311/SW7471[j], SW1311/SW7740[j] (35-45') FGC	(1') SW6010, SW8080, SW8280, ModSW8015/3550, SW8310, SW8270 (5') ModSW8015/3550, ModSW8015/5030, SW8310, SW8270, SW8080, SW8280 (15-25') FGC, TO-14 (30') ModSW8015/3550, ModSW8015/5030, SW8080, SW8270, SW8280, SW8310, SW7060, SW7471, SW7740 SW6010, SW1311/SW6010[j], SW1311/SW7060[j], SW1311/SW7471[j], SW1311/SW7740[j], SW9012, SW9045 (35-45') FGC	(15-25') FGC (35-45') FGC (55-65') FGC (75-85') FGC (90-100') FGC (groundwater) SW8260[c,i], SW6010D, SW8270, SW7060D, SW7421D, SW7740D, SW7470D

(Continued)

TABLE 5.11-4. (Continued)

Location:	CS 12 — Burial Pit		
Potential Contaminants of Concern:	VOCs, SVOCs, PCBs, PAHs, Dioxins/furans, TPH, Inorganic species, Cyanide, Acids, Bases		
Sampling Location:	Borings SB15, SB16	Boring SB17-SB20	Borings SB14, SB21[c]
Sample Depth and Analytical Method:	(15-25' in waste) ModSW8015/3550[a], SW8270[a], SW8080[a], SW8280[a], SW9012[a], SW9045[a], SW6010, SW7060, SW7471, SW7740, SW7841, ModSW8015/5030, SW8310[a] (15-25') FGC (35') ModSW8015/3550, ModSW8015/5030, SW8270, SW8080, SW8280, SW9012, SW9045,SW6010, SW7060, SW7471, SW7740, SW8310, SW1311/SW6010[j], SW1311/SW7060[j], SW1311/SW7471[j], SW1311/SW7740[j] (35-45') FGC	(1') ModSW8015/3550, SW8270, SW8310, SW8080, SW8280, SW6010 (5') ModSW8015/3550, ModSW8015/5030, SW8270, SW8310, SW8080, SW8280 (15-25' in waste) ModSW8015/3550[a], SW8270[a], SW8080[a], SW8280[a], SW9012[a], SW9045[a], SW6010, SW7060, SW7471, SW7740, ModSW8015/5030, E218.6[d], SW8310[a] (15-25') FGC (35') ModSW8015/3550, ModSW8015/5030, SW8270, SW8080, SW8280, SW8310, SW9012, SW9045, SW6010, SW7060, SW7471, SW7740, E218.6[d], SW1311/SW6010[j], SW1311/SW7060[j], SW1311/SW7471[j], SW1311/SW7740[j] (35-45') FGC	(15-25') FGC (35-45') FGC (55-65') FGC (75-85') FGC (90-100') FGC (groundwater) SW8260[c,i], SW6010D, SW8270, SW7060D, SW7421D, SW7740D, SW7470D

(Continued)

TABLE 5.11-4. (Continued)

Location:	CS 13 — Burial Pit			
Potential Contaminants of Concern:	VOCs, SVOCs, PCBs, PAHs, Dioxins/furans, Petroleum hydrocarbons, Inorganics species, Cyanide, Acids, Bases			
Sampling Location:	Boring SB10	Boring SB11	Borings SB8, SB9, SB12	Boring SB13
Sample Depth and Analytical Method:	(4–14′ in waste) ModSW8015/3550[a], SW8270[a], SW8080[a], SW8280[a], SW9012[a], SW9045[a], SW6010, SW7060, SW7471, SW7740, SW8310[a], Mod/SW8015/5030, E218.6 (15-25′) FGC (30′) ModSW8015/3550, ModSW8015/5030, SW8270, SW8080, SW8280, SW9012, SW6010, SW7060, SW7471, SW7740, SW8310, E218.6, SW9045, SW1311/SW6010[j], SW1311/SW7060[j], SW1311/SW7471[j], SW1311/SW7740[j] (35-45′) FGC	(5–15′ in waste) ModSW8015/3550[a], SW8270[a], SW8080[a], SW8280[a], SW9012[a], SW9045[a], SW6010, SW7060, SW7471, SW7740, ModSW8015/5030, SW8310[a], E218.6 (15-25′) FGC (25′) ModSW8015/3550, ModSW8015/5030, SW8270, SW8080, SW8280, SW9012, SW9045, SW6010, SW7060, SW7471, SW7740, SW8310, E218.6, SW1311/SW6010[j], SW1311/SW7060[j], SW1311/SW7471[j], SW1311/SW7740[j] (35-45′) FGC	(20′) ModSW8015/3550, ModSW8015/5030, SW8270, SW8080, SW8280, SW9012, SW9045, SW6010, SW7060, SW7471, SW7740, SW8310, SW1311/SW6010[j], SW1311/SW7060[j], SW1311/SW7471[j], SW1311/SW7740[j] (15-25′) FGC (35-45′) FGC	(15-25′) FGC (35-45′) FGC (55-65′) FGC (75-85′) FGC (90-100′) FGC (groundwater) SW8260[c,i], SW6010D, SW8270, SW7060D, SW7421D, SW7740D, SW7470D

(Continued)

TABLE 5.11-4. (Continued)

Location:	CS 14 - Burial Pit		Fire Training Area[h]	Don Julio Creek	Drainage Ditch
Potential Contaminants of Concern:	VOCs, SVOCs, PCBs, PAHs, Dioxins/furans, Petroleum hydrocarbons, Inorganics species, Cyanide, Acids, Bases		Petroleum hydrocarbons, PAHs, PCBs, Dioxins/furans, Inorganic species	Petroleum hydrocarbons, SVOCs, Inorganic species	Petroleum hydrocarbons, SVOCs, Inorganic species
Sampling Location:	Borings SB2–SB6	Borings SB1, SB7	Borings SB34–SB37	Surface Scrape MC1	Hand Auger HA1
Sample Depth and Analytical Method:	(15–25') FGC (15–25' in waste) ModSW8015/3550[a], SW8270[a], SW8080[a], SW8280, SW9012[a], SW9045[a], SW6010, SW7060, SW7471, SW7740, E218.6[f], ModSW8015/5030, SW8310[a] (35–45') FGC (40') ModSW8015/3550, ModSW8015/5030, SW8270, SW8080, SW8280, SW9012, SW9045, SW6010, SW7060, SW7471, SW7740, E218.6[f], ModSW8015/5030, SW8310, SW1311/SW6010[j], SW1311/SW7060[j], SW1311/SW7471[j], SW1311/SW7740[j]	(15–25') FGC (35–45') FGC (55-65') FGC (75-85') FGC (90-100') FGC (groundwater) SW8260[c,d], SW6010D, SW8270, SW7060D, SW7421D, SW7740D, SW7470D	(1') SW6010, ModSW8015/3550, SW8310, SW8270, SW8080, SW8280 (5') ModSW8015/3550, ModSW8015/5030, SW8270, SW8310, SW8080, SW8280 (15–20') ModSW8015/3550, ModSW8015/5030, SW8270 (15–25') FGC (35–45') FGC	(0–0.25') ModSW8015/3550, SW8270, SW6010	(0-0.25')[g] ModSW8015/3550, SW6010 (1') SW8270 (5') ModSW8015/3550, SW8270, SW6010

(I ɔtes presented on following page.)

TABLE 5.11-4. (Continued)

[a] 4:1 composite samples. Samples will be collected over interval specified and composited for analysis. Inorganic samples (not composited) will be collected at bottom of interval.
[b] SB28 and SB30 only.
[c] For SW8240 analytes.
[d] SB18 and SB19 only.
[e] Four samples will be collected for bulk density analysis (ASTM 2937) in different soil types.
[f] Borings SB3 and SB5 only.
[g] 5:1 composite samples of creek sediments.
[h] Borings are also located in Contaminated Soils Holding Area.
[i] The benefits and limitations of Method SW8260 are currently being compared with Methods SW8010 and SW8020. Depending on the outcome of this review, Methods SW8010 and SW8020 may be used instead of SW8260.
[j] The sample yielding the highest concentration of inorganic constituents relative to the constituent's toxicity (see Section 4.3.2) in each pit will be analyzed for soluble metal concentrations.

FGC = Screening analysis of soil gas for commonly detected VOCs with on-site chromatograph.

NOTE: Matrix represents the minimum number of samples to be collected in each horizon.
FGC analyses will be confirmed with 10% TO-14 analysis.
Specific sample depths will be determined in the field using the sampling criteria specified in Section 4.
All acronyms are defined on the acronym list at the beginning of the SAP.

TABLE 5.11-5. SAMPLING AND FIELD SPECIFICATIONS FOR IC 19

Boring/Location Name	Reference Point	Distance	Maximum Depth Interval (ft BGS)
Hand Auger			
HA1	363,100 N, 2,168,100 E	13'S, 150'E	5
Borings			
SB1	Southwest corner of Bldg. 1088	11'N, 228'W	100
SB2	363,700 N, 2,167, 500 E	69'S, 24'W	45
SB3	363,700 N, 2,167,500 E	176'S, 12'W	45
SB4	363,200 N, 2,167,550 E	226'N, 72'W	45
SB5	363,200 N, 2,167,550 E	113'N, 75'W	45
SB6	363,200 N, 2,167,550 E	7'S, 86'W	45
SB7	363,200 N, 2,167,550 E	91'S, 77'W	100
SB8	363,700 N, 2,167,500 E	116'S, 130'E	45
SB9	363,700 N, 2,167,500 E	232'S, 133'E	45
SB10	363,200 N, 2,167,550 E	165'N, 99'E	45
SB11	363,200 N, 2,167,550 E	79'N, 114'E	45
SB12	363,200 N, 2,167,550 E	45'S, 150'E	45
SB13	363,200 N, 2,167,550 E	160'S, 127'E	100
SB14	363,700 N, 2,167,000 E	39'N, 206'W	100
SB15	363,700 N, 2,167,750 E	69'S, 24'E	45
SB16	363,700 N, 2,167,750 E	180'S, 20'E	45
SB17	363,700 N, 2,167,750 E	270'S, 59'W	45
SB18	363,100 N, 2,168,100 E	230'N, 254'W	45
SB19	363,100 N, 2,168,100 E	133'N, 273'W	45
SB20	363,100 N, 2,168,100 E	72'N, 217'W	45
SB21	363,100 N, 2,168,100 E	84'S, 232'W	100
SB22	363,700 N, 2,168,000 E	4'N, 3'W	100
SB23	363,700 N, 2,167,000 E	182'S, 21'W	45
SB24	363,500N, 2,168,000 E	88'S, 9'E	45
SB25	363,100 N, 2,168,100 E	304'N, 41'W	45
SB26	363,100 N, 2,168,100 E	225'N, 27'W	45
SB27	363,100 N, 2,168,100 E	95'N, 36'W	100
SB28	363,700 N, 2,168,000 E	22'S, 128'E	45
SB29	363,700 N, 2,168,000 E	86'S, 160'E	45
SB30	363,500 N, 2,168,000 E	187'N, 186'E	45
SB31	363,500 N, 2,168,000 E	46'S, 229'E	45
SB32	363,100 N, 2,168,100 E	264'N, 130'E	45
SB33	363,100 N, 2,168,100 E	153'N, 132'E	100
SB34	363,700 N, 2,167,750 E	195'S, 148'E	45
SB35	363,300 N, 2,168,000 E	62'N, 63'W	45
SB36	363,300 N, 2,168,000 E	25'S, 90'W	45
SB37	363,300 N, 2,168,000 E	13'S, 0'E	45
Surface Scrape			
MC1	363,200 N, 2,167,550 E	226'S, 225'W	0.25

5.12 Field Sampling Plan for Investigation Cluster (IC) 20 (Potential Release Location [PRL] 9, PRL S-46, PRL 66D, and PRL L-7D)

Investigation Cluster 20 comprises PRL 9, PRL S-46, PRL 66D, and a section of the Industrial Wastewater Line (IWL) (PRL L-7D) (Figure 5.12-1). The IC is in the northeastern portion of Operable Unit (OU) C.

Potential Release Location 9 was reported to be a burn debris burial pit. Aerial photographs show piles of soil and construction rubble, which were verified by McLaren in a 1985 site visit (McLaren, 1986b). No information is available about the quantity and types of waste disposed at the location. Previous investigations yielded no evidence that PRL 9 was a burial pit. A ground penetrating radar (GPR) survey was unsuccessful in locating burial pit boundaries.

Potential Release Location 66D includes the drainage area directly west of two hush houses (Building 7602 and 7604) and two test stands (Building 774). The location extends to approximately 150 feet west of the buildings. The test stands in Building 774 are first visible in a 1972 aerial photograph; the hush houses are visible after 1985 (7604 in 1986, 7602 in 1987). Prior to installation of the IWL in 1988, PRL 66D received all the drainage from testing and maintenance operations in the test stands.

The IWL at PRL L-7D is approximately 1,250 feet long and carries liquid waste from OU D and from the test stands and hush houses to the Industrial Wastewater Treatment Plant (IWTP). Wastewater is collected in two small sumps near the west side of each test stand in Building 774 and is released by gravity flow to the IWL. The location of lines connecting the sumps at Building 774 and connecting Buildings 7600, 7601, 7602, and 7604 to the IWL are not known. Flow in this section of the IWL is assisted by two lift stations. A small sump is located southwest of Building 774 (CH2M HILL, 1993); it receives liquids from Building 774 and drains to the IWL. This section of the IWL has never been inspected. It is scheduled for inspection in 1994.

Potential Release Location S-46 is located in the northernmost portion of IC 20. Two hush houses (Buildings 7600 and 7601) and Taxi Lane 7807 partially cover the location. Prior to construction of the two hush houses in 1989, six borings were drilled and sampled by McClellan Air Force Base (AFB) Environmental Management (EM). Analytical results indicated low levels of benzene, toluene, ethylbenzene, and xylene (BTEX) were present in soils from 1 to 15 feet below ground surface (BGS). Arsenic, cadmium, copper, mercury, lead, selenium, and thallium were reported above subsurface background values.

Previous investigations conducted at IC 20 are summarized in Table 5.12-1.

5.12.1 Data Quality Objectives

The data quality objectives for this phase of the Remedial Investigation (RI) at IC 20 are shown on Table 5.12-2.

5.12.2 Sampling Plan

Proposed boring locations are shown in Figure 5.12-2. Overlay A shows the locations of previous borings at IC 20. Potential contaminants of concern and the sampling and analysis matrix for IC 20 are shown in Table

5.12-3; field specifications for sampling locations are included in Table 5.12-4.

Rationale and specific objectives for sampling locations are outlined below.

Sixteen borings (SB1, SB3–SB17) will be drilled and sampled along the IWL to identify areas where leaks in the IWL may have contaminated the subsurface. Because the IWL in IC 20 has never been inspected or tested, borings will be placed at the lift stations and at 100-foot intervals.

Borings SB2, SB4, SB21, and SB22 through SB31 will be drilled between the hush houses near PRL S-46 and PRL 66D and sampled to determine if soil and/or soil gas contamination is present at the location.

Five hand augers (HA2–HA6) will be drilled in the open drainage areas (topographic lows) of PRL 66D to determine if surface and shallow soils are contaminated.

Boring SB2 will be drilled and sampled near the sumps that collect wastewater from Building 774. Analytical results from these samples will indicate if leaks in the sumps and/or drainage from the buildings has contaminated PRL 66D.

Four borings (SB18 through SB20) will be drilled and sampled approximately 100 feet apart through the center of PRL 9. Both soil and soil gas samples will be collected from these borings to determine if any waste materials were buried at PRL 9 and if these materials have contaminated the subsurface.

Six hand augers (HA1, HA7–HA10)) will be drilled and sampled in the drainage ditches at IC 20 to determine if any contaminants have entered the ditches in runoff from the test stands and hush houses.

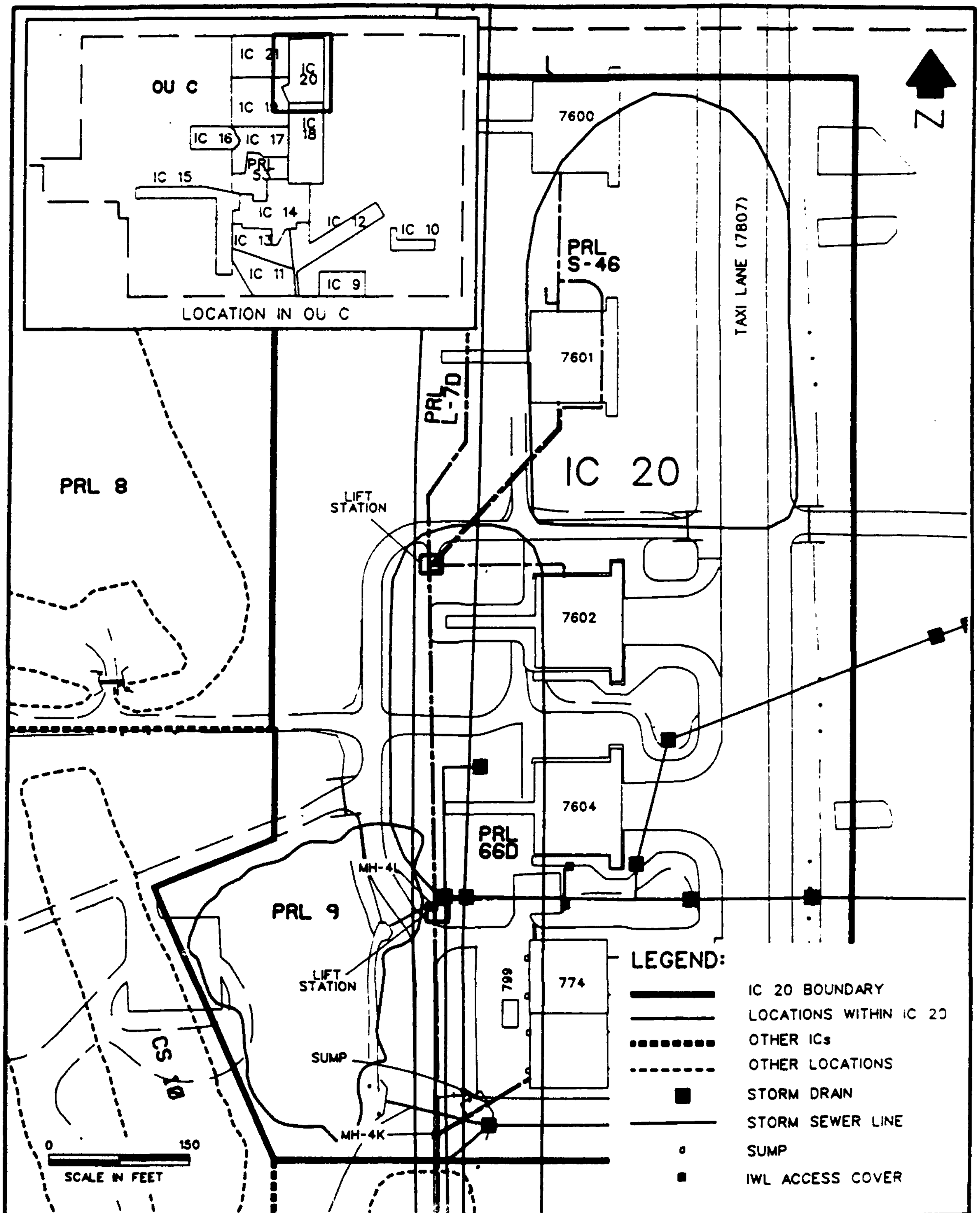


Figure 5.12-1 Potential Discharge Areas in IC 20

OUC4 IC20PSL VRL SAC 2/23/94

TABLE 5.12-1. PREVIOUS INVESTIGATIONS AT IC 20

Year, Contractor	Scope of Investigation	Key Findings
1985, McLaren Environmental Engineering	Investigation of potential contamination at PRL 9. Four deep borings, two waste sample borings, and one cased waste sample boring were placed. A GPR survey was also conducted.	Buried waste was not encountered. GPR survey was unsuccessful at locating burial pit boundaries. The only sample collected reported toluene at 17 $\mu g/kg$ at 31 feet BGS.
1988, McClellan AFB EM	Investigation of potential contamination at PRL S-46. Six borings were drilled.	Samples collected contained < 44 mg/kg xylenes, < 26 mg/kg toluene, < 12 mg/kg ethylbenzene, and inorganic concentrations above subsurface background.
1993, CH2M HILL	Preliminary Assessment of sites and locations in OU C.	Identified areas to be investigated in OU C through records review, site visits, and interviews with base personnel.
1993, Jacobs Engineering Group	Investigaiton of the IWL.	Rated the section of the line between MH-4K and Building 774 as having a moderate potential for leakage.

NOTE: All acronyms are defined in the acronym list at the beginning of the SAP.

TABLE 5.12-2. DATA QUALITY OBJECTIVES FOR PRL 9

Problem Statement Hazardous waste may have been disposed into the pit at PRL 9.
Decision to be Made • Determine if the burial pit exists. • Determine if contaminants are present in the pit. • Determine the location priority.
Inputs to Decision Level II/III for VOCs in soil gas; Level III for SVOCs, TPH, and inorganics in soils.
Boundaries of the Study Soil gas samples will be collected from approximately 20 to 40 feet BGS. Subsurface soil samples will be collected from 10 feet BGS within the boundaries of PRL 9.
Decision Rule • If physical evidence of waste or disturbed soil is found, together with positive analytical data, then the location was used as a burial pit. • If suites of VOCs reported in soil gas surrounding the pit are similar to suites of VOCs reported in soil gas from within the pit, and if concentrations decrease with distance from the pit horizontally, then the VOC contamination most likely originates at the pit. • If organic compounds are reported in soil samples, then the subsurface is contaminated. • If inorganics are reported above subsurface background concentrations in soil samples, then inorganic contamination may exist and the decision process for inorganic species should be applied. • If data collected are validated, then proceed to Data Evaluation DQOs (see Section 4.2.2).
Limits on Uncertainty Analytical data must meet project specifications for precision and accuracy.
Sample Design Borings SB18–SB20 will be drilled at 100-foot intervals through the center of PRL 9.

(Continued)

TABLE 5.12-2. (Continued)

DATA QUALITY OBJECTIVES FOR PRL 66D AND PRL S-46

Problem Statement

Contaminants may have spilled or washed onto the surface, and/or drained into the subsurface at PRL 66D and PRL S-46.

Decision to be Made

- Determine if the surface and/or subsurface has been contaminated by materials that have drained from the nearby hush houses and test stands.
- Determine if sumps west of the buildings have contaminated the subsurface.
- Determine the location priority.

Inputs to the Decision

Level II/III for VOCs in soil gas; Level III for SVOCs, TPH, and inorganic species in soil.

Boundaries of the Study

Soil gas samples will be collected from approximately 20 to 40 feet BGS. Soil samples will be collected at surface to 10 feet BGS.

Decision Rule

- If organic compounds are reported in soil samples, then the surface and/or subsurface has most likely been contaminated by drainage from test stands and hush houses or leaks in the sumps.
- If inorganic species are reported above background concentrations, then inorganic contamination may exist and the decision process for inorganic species should be applied.
- If suites of VOCs reported in soil gas surrounding the test cells and hush houses are similar to suites of VOCs reported in soil gas adjacent to the sumps, and if concentrations decrease with distance from the sumps horizontally, then VOC contamination most likely originates at the sump.
- If all data collected are validated, then proceed to Data Evaluation DQOs (see Section 4.2.2).

Limits on Uncertainty

Analytical data must meet project specifications for precision and accuracy.

Sample Design

In PRL 66D, borings SB4, SB21, and SB22 will be drilled between the hush houses; boring SB2 will be drilled near the sumps; hand augers HA2-HA6 will be drilled in the open drainage areas. In PRL S-46, borings SB10, SB13, and SB17 will be drilled to characterize any surface and subsurface contamination.

(Continued)

TABLE 5.12-2. (Continued)

DATA QUALITY OBJECTIVES FOR PRL L-7D

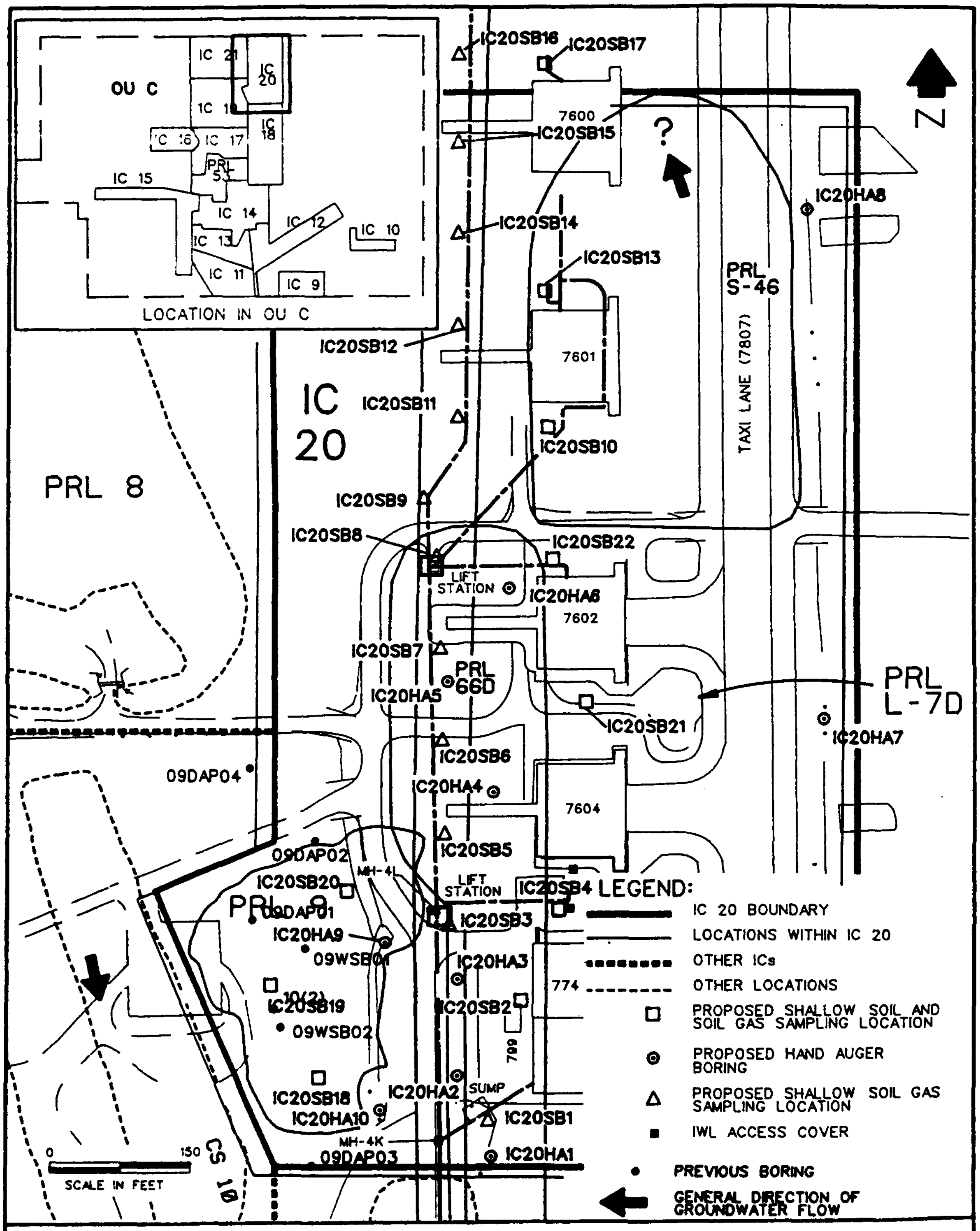
Problem Statement Wastewater carried in the IWL (PRL L-7D) may have leaked and contaminated the subsurface.
Decision to be Made • Determine if leaks in the IWL (PRL L-7D) and/or the sump and lift stations have contaminated the soil gas. • Determine the location priority.
Inputs to the Decision Level II/III for VOCs in soil gas.
Boundaries of the Study Soil gas samples from approximately 20 to 40 feet BGS.
Decision Rule • If VOCs are reported in soil gas along the IWL, and if concentrations decrease with distance from the line horizontally, then VOC contamination most likely originates at the IWL. • If all data collected are validated, then apply Data Evaluation DQOs (see Section 4.2.2).
Limits on Uncertainty Analytical data must meet project specifications for precision and accuracy.
Sample Design Boring SB1 is located next to a sump along the IWL connector line. Borings SB3 and SB8 are located next to lift stations. Borings SB4–SB16 are located at approximately 100-foot intervals and/or next to IWL outlets from buildings.

(Continued)

TABLE 5.12-2. (Continued)

DATA QUALITY OBJECTIVES FOR DRAINAGE DITCHES IN IC 20

Problem Statement Contaminants from locations in IC 20 may have run off and contaminated the sediments and the subsurface in drainage ditches.
Decision to be Made • Determine if organic or inorganic species have entered the drainage ditches. • Determine the location priority.
Inputs to the Decision Level III for SVOCs, TPH, and inorganics in soil.
Boundaries of the Study Soil samples will be collected from the bottom of the ditch or swale to 5 feet below the ditch.
Decision Rule • If organic compounds are reported in soil samples, then sediments or soil are contaminated. • If inorganic species are reported above background concentrations, then sediments may be contaminated and the decision process for inorganic species should be applied. • If all data collected are validated, then apply Data Evaluation DQOs (see Section 4.2.2).
Limits on Uncertainty Analytical data must meet project specifications for precision and accuracy.
Sample Design Hand augers HA1 and HA7–HA10 will be drilled in the drainage ditches at bends, confluences, and exit points.



Overlay A. Previous Sampling Locations

Figure 5.12-2 Proposed Sampling Locations in IC 20

OUC4 IC20PSL SAC 2/28/94

TABLE 5.12-3. SAMPLING AND ANALYSIS MATRIX FOR IC 20

Location:	PRL 9		PRL 66D		PRL S-46
Contaminant of Concern:	Unknown		VOCs, SVOCs, TPH, Inorganic species		VOCs, SVOCs, TPH, Inorganic species
Sampling Location:	Borings SB18–SB20	Borings SB4, SB21, SB22	Boring SB2	Hand Augers HA2-HA6	Borings SB10, SB13, SB17
Depth and Analytical Method:	(10′) SW6010, ModSW8015/3550, ModSW8015/5030, SW8270	(0-0.25′) SW6010, ModSW8015/3550	(0-0.25′) SW6010, ModSW8015/3550	(0-0.25′) SW6010, ModSW8015/3550	(0-0.25′) SW6010, ModSW8015/3550
		(1′) SW8270	(1′) SW8270	(1′) SW8270	(1′) SW8270
		(15–25′) FGC	(5′) SW6010, ModSW8015/3550, ModSW8015/5030, SW8270	(5′) SW6010, ModSW8015/3550, ModSW8015/5030, SW8270	
			(10′) SW6010 ModSW8015/3550, ModSW8015/5030, SW8270		
	(15-25′) FGC	(35–45′) FGC	(15–25′) FGC		(15-25′) FGC
	(35–45′) FGC		(35-45′) FGC		(35–45′) FGC

(Continued)

TABLE 5.12-3. (Continued)

Location:	PRL L-7D	Drainage Ditch
Contaminant of Concern:	VOCs	SVOCs, TPH, Inorganic Species
Sampling Location:	Borings SB1, SB3, SB5-SB9, SB11, SB12, SB14-SB16	Hand Augers HA1, HA7-HA10
Depth and Analytical Method:	(15-25') FGC (35-45') FGC	(0-0.25') ModSW8015/3550, SW6010 (1') SW8270 (5') SW6010, ModSW8015/3550, ModSW8015/5030, SW8270

FGC = Screening analysis of soil gas for commonly detected VOCs with on-site chromatograph.

NOTE: Matrix represents the minimum number of samples to be collected in each horizon.
FGC analyses will be confirmed with 10% TO-14 analysis.
Specific sample depths will be determined in the field using the sampling criteria specified in Section 4.
All acronyms are defined on the acronym list at the beginning of the SAP.

TABLE 5.12-4. SAMPLING AND FIELD SPECIFICATIONS FOR IC 20

Boring/Location Name	Reference Point	Distance	Maximum Depth Interval (ft BGS)
Hand Augers			
HA1	Northwest corner of Bldg. 774	228'S, 44'W	5
HA2	Southwest corner of Bldg. 774	19'N, 81'W	5
HA3	Northwest corner of Bldg. 774	38'S, 80'W	5
HA4	Northwest corner of Bldg. 7604 (main portion)	29'S, 40'W	5
HA5	Southwest corner of Bldg. 7602 (main portion)	12'S, 95'W	5
HA6	Northwest corner of Bldg. 7602 (main portion)	12'S, 29'W	5
HA7	Northwest corner of Bldg. 774	240'N, 309'E	5
HA8	Northwest corner of Bldg. 774	794'N, 292'E	5
HA9	Northwest corner of Bldg. 774	1'N, 157'W	5
HA10	Northwest corner of Bldg. 774	178'S, 161'W	5
Borings			
SB1	Northwest corner of Bldg. 774	180'S, 30'W	45
SB2	Northwest corner of Bldg. 774	62'S, 13'W	45
SB3	Northwest corner of Bldg. 774	19'N, 87'W	45
SB4	Northwest corner of Bldg. 7602 (main portion)	135'S, 53'E	45
SB5	Northwest corner of Bldg. 774	119'N, 93'W	45
SB6	Northwest corner of Bldg. 7604 (main portion)	24'N, 98'W	45
SB7	Northwest corner of Bldg. 7602 (main portion)	76'S, 103'W	45
SB8	Northwest corner of Bldg. 7602 (main portion)	25'N, 106'W	45
SB9	Northwest corner of Bldg. 7602 (main portion)	74'N, 126'W	45
SB10	Southwest corner of Bldg. 7601 (main portion)	27'S, 17'E	45
SB11	Southwest corner of Bldg. 7601 (main portion)	18'S, 77'W	45
SB12	Northwest corner of Bldg. 7601 (main portion)	17'S, 78'W	45
SB13	Northwest corner of Bldg. 7601 (main portion)	20'N, 13'E	45
SB14	Northwest corner of Bldg. 7601 (main portion)	82'N, 77'W	45
SB15	Southwest corner of Bldg. 7600 (main portion)	31'N, 78'W	45
SB16	Northwest corner of Bldg. 7600 (main portion)	27'N, 77'W	45
SB17	Northwest corner of Bldg. 7600 (main portion)	19'N, 13'E	45
SB18	Northwest corner of Bldg. 774	142'S, 230'W	45
SB19	Northwest corner of Bldg. 799	18'N, 249'W	45
SB20	Northwest corner of Bldg. 774	57'N, 197'W	45
SB21	Northwest corner of Bldg. 799	120'N, 166'W	45
SB22	Northwest corner of Bldg. 7602 (main portion)	19'N, 16'E	45

5.13 Field Sampling Plan for Investigation Cluster (IC) 21 (Confirmed Site [CS] 7, Potential Release Location [PRL] 8, the Small Arms Firing Range, and Tanks 701 and 712)

Investigation Cluster 21 comprises CS 7, PRL 8, the abandoned underground storage tank (UST) at Building 712, the location of a removed UST at Building 701, and the Small Arms Firing Range north of Building 712 (Figure 5.13-1). The IC is located in the northern portion of Operable Unit (OU) C. A site summary figure (Figure 5.13-2) illustrates what is known about the site.

Confirmed Site 7 was used as a landfill or burial pit from about 1966 to about the mid-1970s. The site is reported to have been used as an industrial sludge and burning pit, and as a sludge and oil pit (CH2M HILL, 1993). Wastes found in the landfill during previous investigations include plastic, paper, metal, cloth, and wood. Much of the waste was unburned. The landfill also reportedly received sludge from the Industrial Wastewater Treatment Plant (IWTP), drums of solvents, cyanide, medical supplies, and batteries; both wet and dry waste streams were added to the landfill. Although the southern boundary of the landfill has been determined, the northern boundary has not.

Potential Release Location 8 is the base landfill, a 1.5-acre, unlined Class II-1 landfill that operated between 1974 and 1981 (CH2M HILL, 1993). Wastes were put into a trench that was originally about 435 feet long, 135 feet wide, and 30 to 40 feet deep. Berms 10 to 50 feet high lined the trench's east and west sides. Waste was put into the trench from the north and south; as more waste was added, a hole or pit was gradually created near the center of the landfill in the middle of the waste mounds. In 1978, the pit was about 120 feet long, 100 feet wide, and 30 feet deep; by 1984, the pit had been reduced to approximately 70 feet long. Rainwater that collected in this pit may have served as a driving force for contaminant migration. This pit was filled with imported soil and covered with concrete slabs and a 3-foot thick cover layer of soil in 1988.

The landfill may have received any wastes generated on base during its operational life. As much as one third of the material put in the landfill between 1974 and 1977 may have been dewatered industrial sludge (CH2M HILL, 1993). An estimated 40,000 cubic yards of waste and 12,600 cubic yards of sludge were placed in the landfill.

A ditch directly south of the landfill was used during the early 1980s for the ignition and burning of chafe canisters, which were filled with aluminum shavings (CH2M HILL, 1993).

The Small Arms Firing Range is located northeast of Building 712. It is approximately 300 feet wide by 100 feet long, and backed by a large berm. According to aerial photographs, the range has been there since before 1964. Surface water runoff is collected in a stormwater catchment basin in front of the backstop and discharged west to Don Julio Creek. The range has been included in this SAP, even though the backstop is outside OU C, because of regulatory agency concern about possible contamination.

Tank 701 was located at Building 701, west of CS 7. This 250-gallon diesel tank was installed in 1954 and removed in 1990. Tank 712 is a 300-gallon diesel tank at Building 712 that was installed in 1943 and abandoned in place in 1984.

Previous investigations of IC 21 are summarized in Table 5.13-1.

5.13.1 Data Quality Objectives

Data quality objectives for IC 21 are shown on Table 5.13-2.

5.13.2 Sampling Plan

Proposed sampling locations are shown on Figure 5.13-3; previous sampling locations are shown on Overlay A, including those used to construct cross sections through the area. Cross sections of CS 7 and PRL 8 (Figures 5.13-4 and 5.13-5) were used to target lithologic layers for sample collection. Potential contaminants of concern and the sampling and analytical matrix for IC 21 are shown in Table 5.13-3; field specifications for sampling locations are included in Table 5.13-4.

Because of the likelihood of encountering methane gas at CS 7 and PRL 8, both a photoionization detector (PID) and a flame ionization detector (FID) will be used both for health and safety purposes and to screen vapors for sample collection. A Lower Explosive Limit (LEL) meter will also be used. Adequate precautions will be taken during field activities to prevent combustion of methane; see Appendix B to this SAP.

Rationale and specific objectives for sampling locations are outlined below.

Borings SB1, SB2, and SB3 will be groundwater monitoring wells placed north and south of CS 7 and PRL 8 to determine both groundwater flow directions and whether contaminants (including inorganic species and semivolatile and volatile organic compounds) from either location have migrated to groundwater. A HydroPunch® sample will be collected in boring SB14 to determine water quality north of PRL 8. Groundwater flow directions and groundwater quality in this portion of OU C are currently uncertain. Monitoring well data will support the Groundwater OU RI/FS. All three wells will be screened in the A monitoring zone.

Magnetometer and electromagnetic surveys will be conducted at CS 7 and PRL 8 prior to drilling at the location. If objects which may be buried drums are identified (see Section 4.4), then proposed borings in the area will not be drilled and trenches will be dug to locate the anomally and remove any buried drums. Soil samples will be collected as specified in Section 4.4. Standard operating procedures for digging trenches and removing drums are included in Appendix B to this report.

Soil borings SB4 through SB7 (CS 7) and SB8 through SB13 (PRL 8) will characterize the heterogenous nature of the wastes, and will determine whether contaminants in those wastes have migrated beneath the pit and landfill. Borings will be placed about 100 feet apart. Samples analyzed for organic compounds will be composited 4:1 over approximately 10-foot intervals in the pit material to characterize the contaminants. Discrete samples will be collected from the native soils about 10 feet beneath the pit and landfill. The discrete sample yielding the highest concentration of inorganic constituents relative to the constituents toxicity will be analyzed for soluble metals (Section 4.3.2). Soil gas samples will be collected from within the landfills themselves, as well as from sandy layers beneath them. Boring depths may vary depending on the depth of the bottom of the waste and the decisions made with the boring decision diagram (Section 4.4). Borings drilled through

waste material will be cased to at least 10 feet below the bottom of the pits.

Three hand augers (HA6–HA8) will be drilled in the ditch south of PRL 8 and analyzed by SW6010 to determine whether contaminants (aluminum) from the burned chafe canisters have contaminated sediments.

At the small arms firing range, five trenches will be dug with a backhoe at the base of the backstop and where soil from the backstop may have been spread. Contaminants of concern include total and soluble copper and lead (from the bullets) and semivolatile organic compounds (SVOCs) (SVOCs have been reported in soil from firing ranges at other Department of Defense facilities). Soils from sample locations HA1 and HA5 will be collected at the surface and 3 feet BGS. Samples from HA2 through HA4 will be collected within the first 3 inches of the backstop and 3 feet into the backstop (horizontally). Samples will be composited 5:1 from within the backhoe bucket. Bullets will be removed from the sample with a sieve.

Samples (MS1 and MC2) will be collected from the stormwater catchment basin in front of the firing range backstop and from the creek west of IC 21 to determine if contaminants from the firing range have migrated to the basin and creek. The creek sample (composited 5:1) will be collected at the outfall location of the storm drain line.

Surface scrape MC1 will be collected in the lined creek west of IC 21 to determine whether creek sediments are contaminated with petroleum hydrocarbons, inorganic species, and/or SVOCs. The sample will be composited 5:1.

One boring each will be placed at the tank locations at Buildings 701 (Boring SB15) and 712 (Boring SB16), to determine whether leaks from the tanks have contaminated the soil or soil gas. Tank locations will be confirmed through a record search of Civil Engineering (CE) construction diagrams. If the CE search is unsuccessful, a geophysical (magnetic and electromagnetic) survey will be conducted at Tank 712 (abandoned in place).

Physical parameter samples will be collected from three different soil types in SB3 and SB14 to provide information for vadose zone modeling and for evaluation of remedial action alternatives.

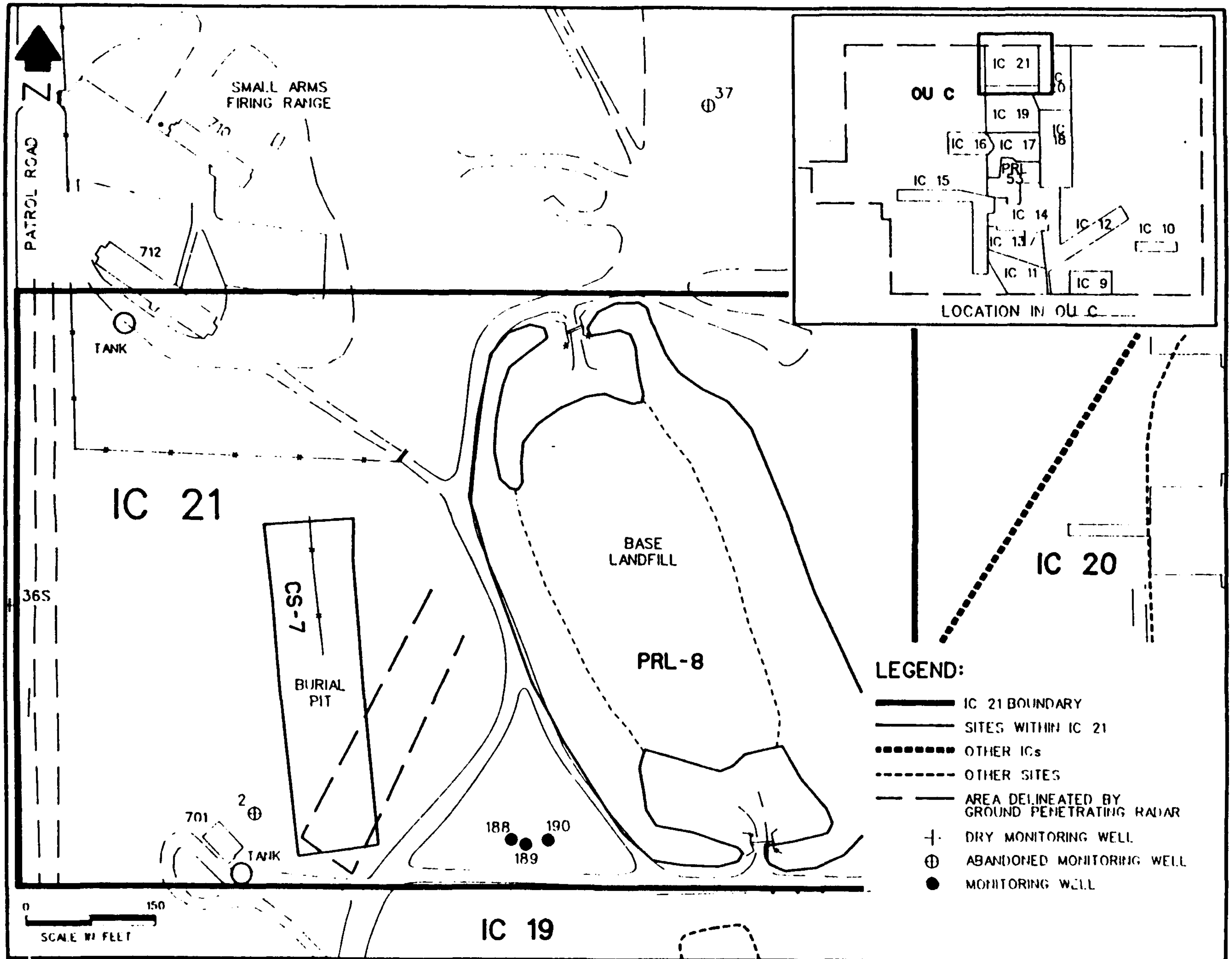
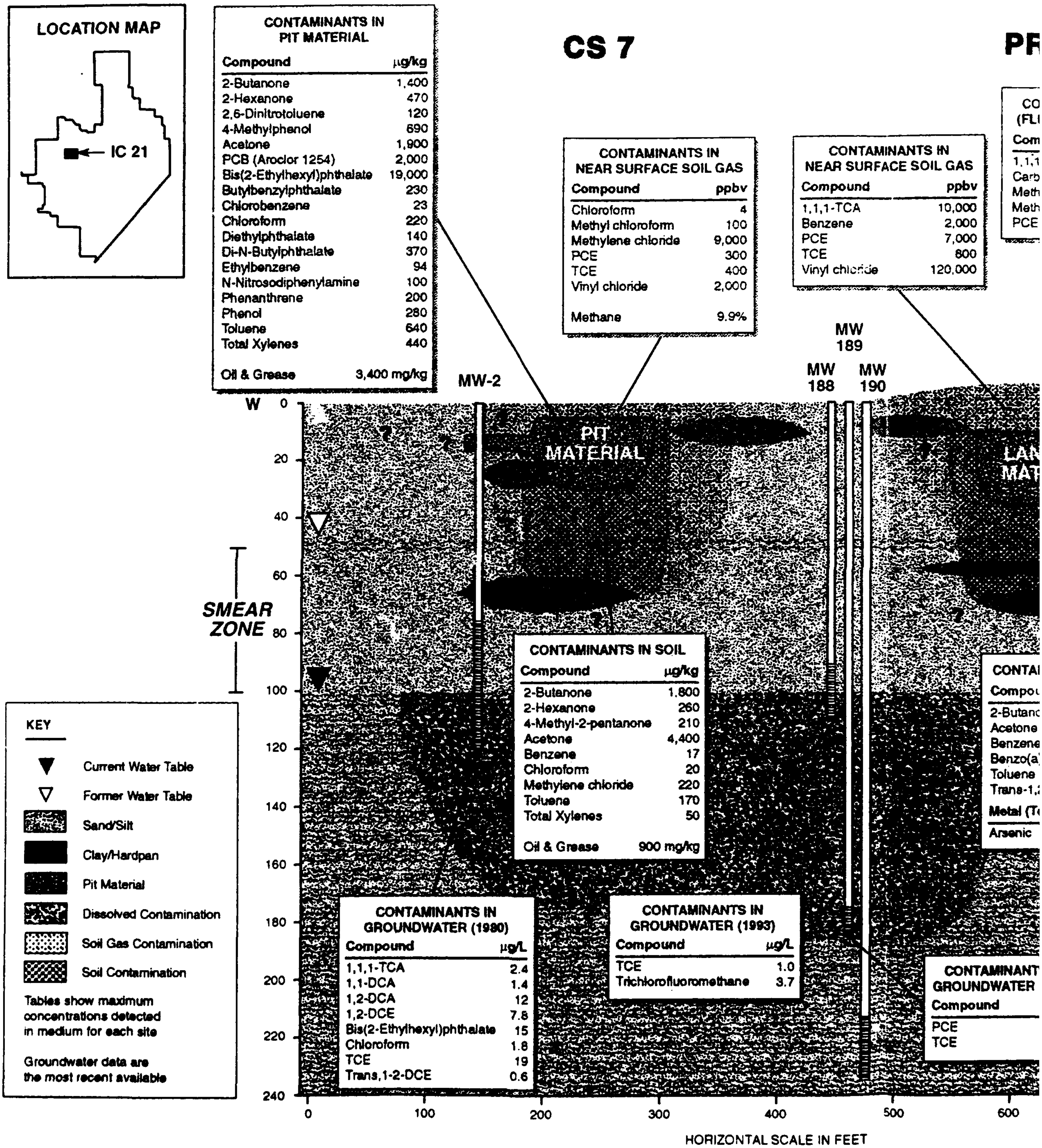


Figure 5.13-1 Potentic' charge Areas at IC 21



CONTAMINANTS IN PIT MATERIAL

Compound	µg/kg
2-Butanone	1,400
2-Hexanone	470
2,6-Dinitrotoluene	120
4-Methylphenol	690
Acetone	1,900
PCB (Aroclor 1254)	2,000
Bis(2-Ethylhexyl)phthalate	19,000
Butylbenzylphthalate	230
Chlorobenzene	23
Chloroform	220
Diethylphthalate	140
Di-N-Butylphthalate	370
Ethylbenzene	94
N-Nitrosodiphenylamine	100
Phenanthrene	200
Phenol	280
Toluene	640
Total Xylenes	440
Oil & Grease	3,400 mg/kg

CONTAMINANTS IN NEAR SURFACE SOIL GAS

Compound	ppbv
Chloroform	4
Methyl chloroform	100
Methylene chloride	9,000
PCE	300
TCE	400
Vinyl chloride	2,000
Methane	9.9%

CONTAMINANTS IN NEAR SURFACE SOIL GAS

Compound	ppbv
1,1,1-TCA	10,000
Benzene	2,000
PCE	7,000
TCE	800
Vinyl chloride	120,000

CO (FL

Com
1,1,1
Carb
Meth
Meth
PCE

CONTAMINANTS IN SOIL

Compound	µg/kg
2-Butanone	1,800
2-Hexanone	260
4-Methyl-2-pentanone	210
Acetone	4,400
Benzene	17
Chloroform	20
Methylene chloride	220
Toluene	170
Total Xylenes	50
Oil & Grease	900 mg/kg

CONTAI

Compou
2-Butano
Acetone
Benzene
Benzo(a)
Toluene
Trans-1,
Metal (T
Arsenic

CONTAMINANTS IN GROUNDWATER (1980)

Compound	µg/L
1,1,1-TCA	2.4
1,1-DCA	1.4
1,2-DCA	12
1,2-DCE	7.8
Bis(2-Ethylhexyl)phthalate	15
Chloroform	1.8
TCE	19
Trans,1-2-DCE	0.6

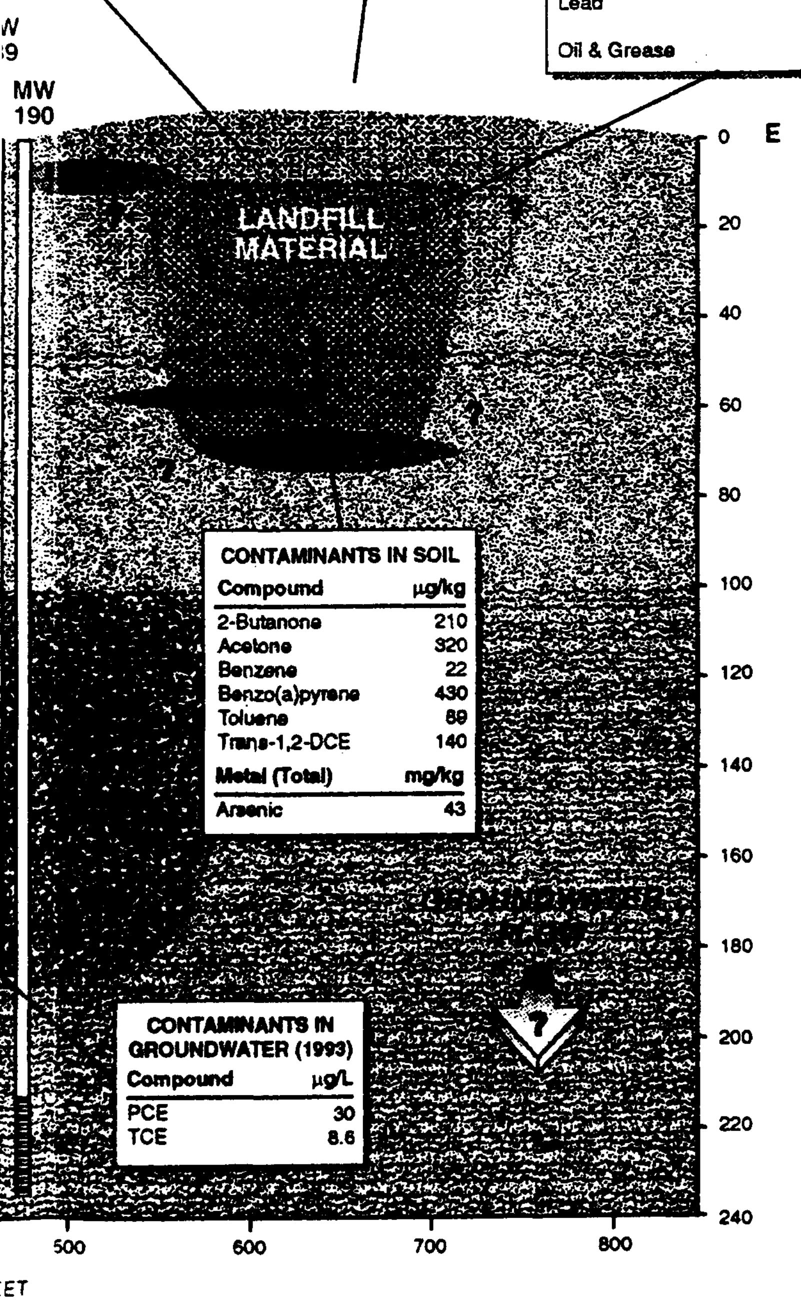
CONTAMINANTS IN GROUNDWATER (1993)

Compound	µg/L
TCE	1.0
Trichlorofluoromethane	3.7

CONTAMINANT GROUNDWATER

Compound
PCE
TCE

PRL 8



CONTAMINANTS IN LANDFILL MATERIAL

Compound	µg/kg
3,4-Benzofluoranthene	560
Benzene	16
Bis(2-Ethylhexyl)phthalate	570
Butylbenzylphthalate	1,300
Chrysene	140
Dibenzo(A,H)anthracene	1,500
Diethylphthalate	160
Di-N-Butylphthalate	380
Di-N-Octylphthalate	130
Indeno(1,2,3-CD)pyrene	1,200
Phenanthrene	120
Metal (Total)	**mg/kg**
Antimony	210
Cadmium	11
Lead	340
Oil & Grease	6170

CONTAMINANTS IN AIR (FLUX MEASUREMENTS)

Compound	ppbv
1,1,1-TCA	0.15
Carbon tetrachloride	0.14
Methane	2,500
Methylene chloride	0.16
PCE	1.6

NTAMINANTS IN ;URFACE SOIL GAS

ınd	ppbv
A	10,000
	2,000
	7,000
	800
oride	120,000

CONTAMINANTS IN SOIL

Compound	µg/kg
2-Butanone	210
Acetone	320
Benzene	22
Benzo(a)pyrene	430
Toluene	89
Trans-1,2-DCE	140
Metal (Total)	**mg/kg**
Arsenic	43

CONTAMINANTS IN GROUNDWATER (1993)

Compound	µg/L
PCE	30
TCE	8.6

Site Status:
-- PA/SIs complete

Source Areas:
-- Pit material (CS 7)
-- Landfill material (PRL 8)

Groundwater Impacts:
-- Potential for contaminant migration will be evaluated during the RI

Completed Evaluated Pathways:
-- Air pathway from flux of VOCs to atmosphere

Evaluated Risks:
-- Health risks will be evaluated during the RI

ARARs Evaluation:
-- Landfill closure requirements for groundwater & methane gas monitoring
-- PCBs will need to meet cleanup goals of 100 mg/kg for subsurface soils

Uncertainties:
-- Groundwater flow direction beneath pits (southern extent of groundwater divide)
-- Whether sites are contributing to groundwater contamination
-- Whether DNAPLs are present
-- Northern boundary of CS 7
-- Presence of hazardous objects, i.e., drums of solvent, concrete
-- Presence of methane gas

Volume/Mass Estimates:
-- Estimated volume of pits:
CS 7 = 812,820 ft^3
PRL 8 = 2,055,375 ft^3
-- Mass will be calculated during RI

Recommendations:
-- Perform Phase I RI
-- Determine if contaminants from the sites have migrated to the subsurface or the groundwater
-- Determine groundwater flow direction
-- Determine contaminant concentrations in the soil gas
-- Determine mass of contaminants

Revision dates:

Figure 5.13-2.
Site Summary Figure for IC 21

IC21.FH3 - VMG 2/25/94 SAC

TABLE 5.13-1. PREVIOUS INVESTIGATIONS AT IC 21

Year, Contractor	Scope of Investigation	Key Findings
1979, McClellan AFB	MW-2 installed as part of an initial investigation of groundwater contamination at McClellan AFB.	A layer of waste 10 feet thick was encountered beneath a 10-foot layer of fill. VOCs above MCLs were detected in groundwater. Well was abandoned in 1981.
1982, Engineering-Science	MW-37S installed north of IC 21 as part of investigation of groundwater contamination.	The only compounds detected were pesticides and lead. The well has been abandoned.
1985, McLaren Environmental Engineers	Investigation of potential contamination at CS 7 and PRL 8; 18 borings were drilled at each location.	Samples were analyzed for VOCs, SVOCs, pesticides, and metals. At CS 7, low levels of VOCs, SVOCs, PCBs, PAHs, and one metal above subsurface background were detected in composited waste samples. At PRL 8, oil and grease, low levels of VOCs and SVOCs, and metals above background were detected in composited waste samples. Debris included wood, plastic, glass, and metal.
1987, Radian Corporation	Landfill gas sampling conducted as part of Phase 1 SWAT. Six probes at CS 7 and 10 probes at PRL 8 were driven to 2-8 feet BGS.	VOCs (including vinyl chloride) were detected in samples from both sites. Methane gas was detected at percent level in samples from CS 7.
1988, McClellan AFB	Nine soil samples were collected from fill material used to fill the pit at PRL 8.	Low levels of VOCs, SVOCs, and metals were detected in fill material. Cadmium, mercury, lead, and selenium were the only metals above subsurface background concentrations.
1989, Radian Corporation	Basewide investigation of surface soil vapor for potential organic contamination.	At CS 7, the maximum OVA reading was 2.7 ppmv.
1989, Radian Corporation	Preliminary Groundwater Operable Unit Remedial Investigation to determine hydrogeologic characteristics beneath McClellan AFB. MWs 188, 189, and 190 were installed.	VOCs below MCLs were detected in groundwater. A pilot hole drilled at CS 7 encountered methane above the LEL; hole was flushed with nitrogen and abandoned.
1992, CH2M HILL	Phase II SWAT included collecting 12 surface emission samples at PRL 8.	Very low levels of TCE, PCE, and carbon tetrachloride were detected, as well as methane about 2,000 ppbv.
1993, CH2M HILL	Preliminary Assessment of sites and locations in OU C	Identified areas to be investigated in OU C records review, site visits, and interviews with base personnel.

NOTE: All acronyms are defined in the acronym list at the beginning of this SAP.

TABLE 5.13-2. DATA QUALITY OBJECTIVES FOR SOIL AND SOIL GAS AT CS 7 AND PRL 8

Problem Statement Industrial sludges, hazardous waste, or other wastes disposed to the landfill and burial pit may have contaminated the subsurface.
Decision to be Made • Determine if contaminants from the landfill have migrated to soil beneath the pits. • Determine the location priority.
Inputs to the Decision Level II/III data for soil gas; Level III for organic and inorganic constituents in soil.
Boundaries of the Study Soil gas samples from about 20 to about 100 feet BGS; waste samples from within the landfill; soil samples from about 10 to 40 feet BGS.
Decision Rules • If organic contaminants are reported in the soil beneath the waste material, then contaminants have migrated from the landfill. • If inorganic species are reported above subsurface background concentrations in soil samples, then inorganic contaminants may have migrated from the landfill, and the decision process for inorganic species should be applied. • If suites of VOCs in deep soil gas (40 to 60 feet BGS) are the same as in shallow soil gas (10 to 20 feet BGS), then VOCs from the landfill have most likely migrated vertically. • If all data collected are validated, proceed to the Data Evaluation DQOs (see Section 4.2.2).
Limits on Uncertainty Analytical data must meet project specifications for precision and accuracy.
Sample Design Four borings in CS 7 (SB4–SB7) and six borings in PRL 8 (SB8–SB11) will be drilled approximately 100 feet apart through the landfills. Samples will be collected from within the waste materials to determine their contents, and approximately 10 feet beneath the bottom of the landfills to determine if contaminants in the landfills have migrated vertically.

(Continued)

TABLE 5.13-2. (Continued)

DATA QUALITY OBJECTIVES FOR TANKS 712 AND 701

Problem Statement

Diesel fuel in the tanks may have leaked and contaminated the subsurface.

Decision to be Made

- Determine if leaks in the tank or piping have contaminated the subsurface.
- Determine if contaminants other than diesel are present that may effect selection of remedial alternatives.
- Determine the location priority.

Inputs to the Decision

Level II/III data for VOCs in soil gas and Level III data for petroleum hydrocarbons in soil.

Boundaries of the Study

Soil gas samples from about 20 to about 40 feet BGS, and soil samples from 10 to 30 feet BGS.

Decision Rule

- If petroleum hydrocarbons are reported in the soil adjacent to and/or beneath the tank, leaks from the tank have contaminated the subsurface.
- If VOCs are reported in the soil gas and if concentrations are greater than adjacent or surrounding borings, the contamination may have originated at this location.
- If all data collected are validated, proceed to the Data Evaluation DQOs (see Section 4.2.2).

Limits on Uncertainty

Analytical data must meet project specifications for precision and accuracy.

Sample Design

Borings SB15 and SB16 will be placed next to estimated location of tanks and piping.

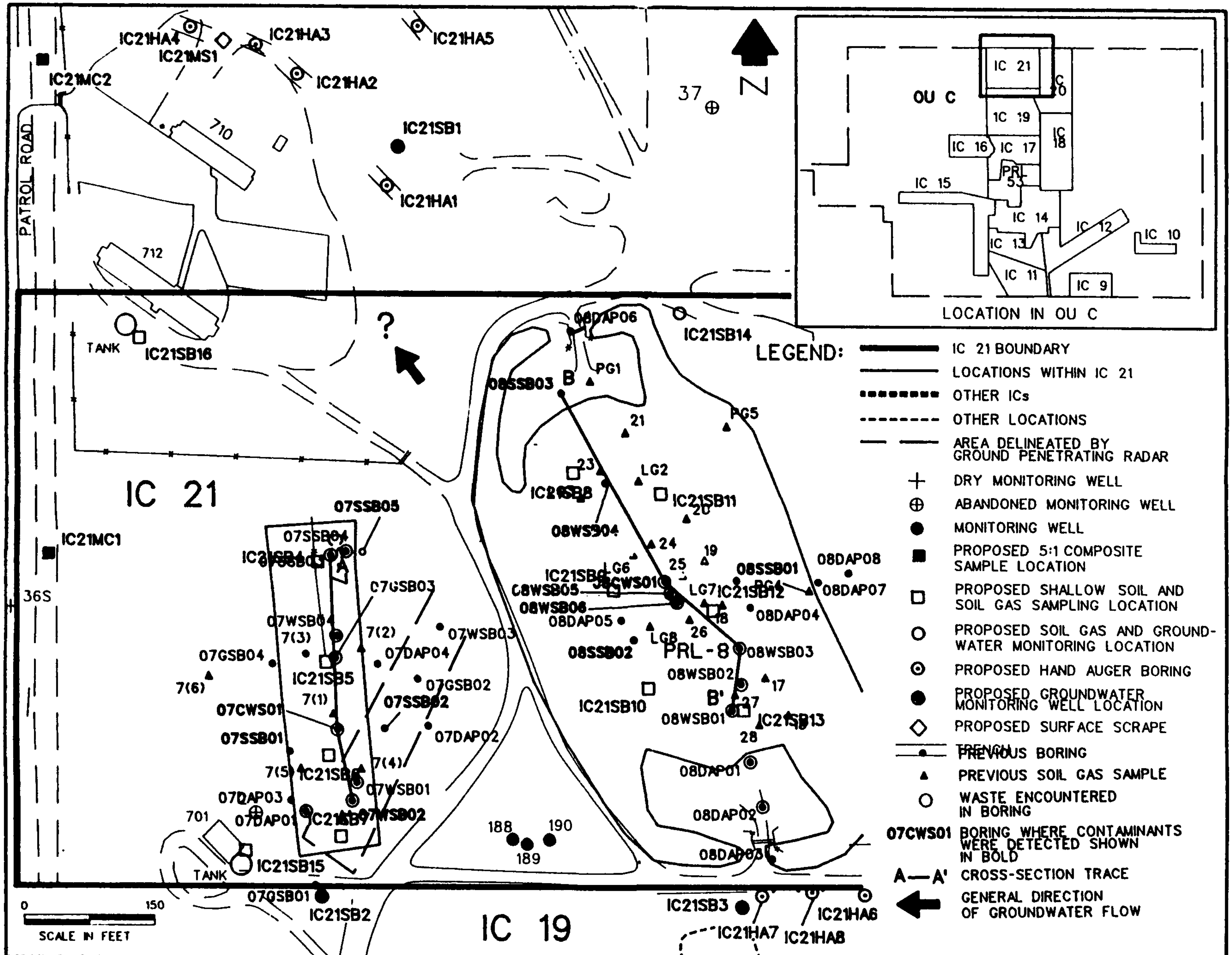
(Continued)

TABLE 5.13-2. (Continued)

DATA QUALITY OBJECTIVES FOR TANKS 712 AND 701

Problem Statement Diesel fuel in the tanks may have leaked and contaminated the subsurface.
Decision to be Made • Determine if leaks in the tank or piping have contaminated the subsurface. • Determine if contaminants other than diesel are present that may effect selection of remedial alternatives. • Determine the location priority.
Inputs to the Decision Level II/III data for VOCs in soil gas and Level III data for petroleum hydrocarbons in soil.
Boundaries of the Study Soil gas samples from about 20 to about 40 feet BGS, and soil samples from 10 to 30 feet BGS.
Decision Rule • If petroleum hydrocarbons are reported in the soil adjacent to and/or beneath the tank, leaks from the tank have contaminated the subsurface. • If VOCs are reported in the soil gas and if concentrations are greater than adjacent or surrounding borings, the contamination may have originated at this location. • If all data collected are validated, proceed to the Data Evaluation DQOs (see Section 4.2.2).
Limits on Uncertainty Analytical data must meet project specifications for precision and accuracy.
Sample Design Borings SB15 and SB16 will be placed next to estimated location of tanks and piping.

(Continued)



Overlay A. Previous Sampling Locations

Figure 5.13-3 Proposed Sampling Locations at IC 21

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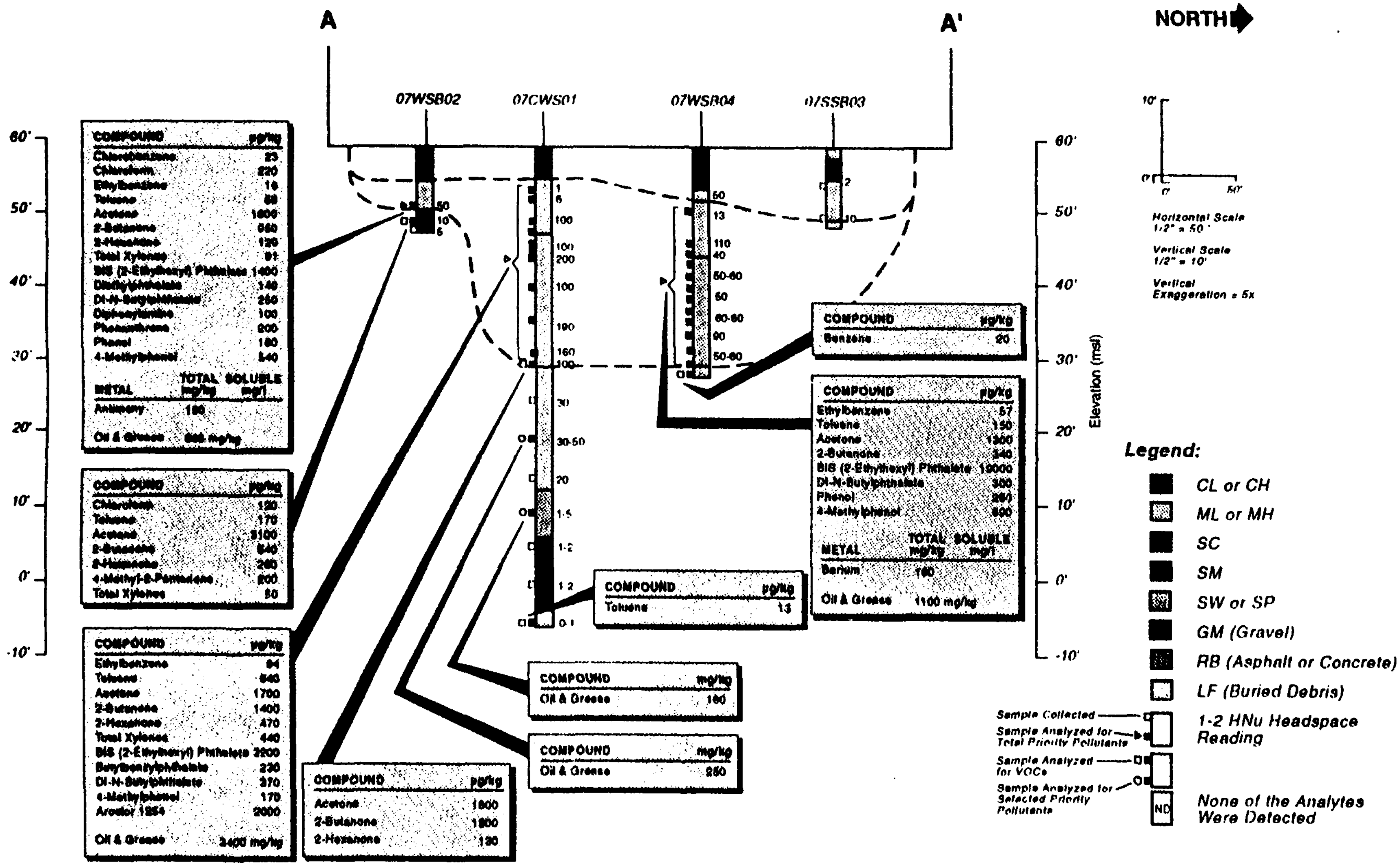

Figure 5.13-4
Cross Section with Positive Analytical Results
CS 7: Landfill

Source: McLaren Environmental Engineering

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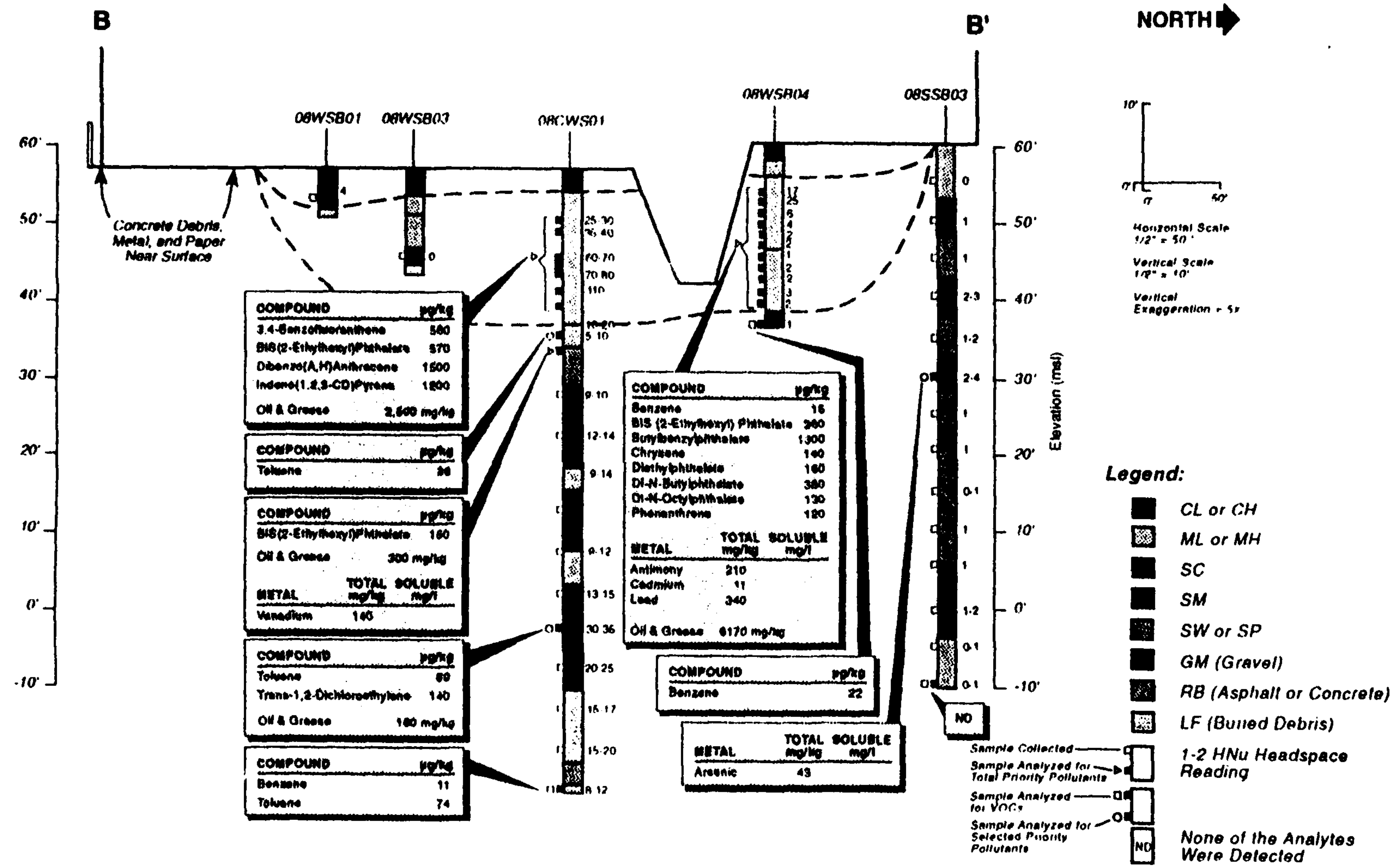


Source: McLaren Environmental Engineering
OUCX9.FH3 - VMG 2/21/94 SAC

Figure 5.13-5
Cross Section of PRL 8 with Positive Analytical Results
PRL 8: Base Landfill

TABLE 5.13-3. SAMPLING AND ANALYTICAL MATRIX FOR IC 21

Location:	CS 7 - Burial Pit		Groundwater	PRL 8 — Base Landfill	
Potential Contaminant of Concern:	VOCs, SVOCs, PAHs, PCBs, Dioxins/furans Inorganic species, Cyanide, TPH, Acids, Bases		VOCs, SVOCs, TPH, Inorganic species	VOCs, SVOCs, PAHs, PCBs, Dioxins/furans, TPH, Inorganic species, Cyanide, Acids, Bases	
Sampling Location:	Borings SB4-SB6	Boring SB7	Borings SB1-SB3[c], SB14[c]	Boring SB9	Borings SB8, SB10-SB13
Sample Depth and Analytical Method:	(10-20' in waste) ModSW8015/3550[a], SW8270[a], SW8080[a], SW8280[a], SW9012[a], SW9045[a], SW6010, SW7060, SW7471, SW7740, ModSW8015/5030, SW8310[a], E218.6[b] (15-25' in waste) FGC, TO-14 (20-30' in waste) ModSW8015/3550, SW8270[a], SW8080[a], SW8280[a], SW9012[a], SW9045[a], SW6010, SW7060, SW7471, SW7740, ModSW8015/5030, SW8310[a], E218.6[b] (40') ModSW8015/3550, ModSW8015/5030, SW8270, SW8280, SW8080, SW9012, SW9045, SW6010, SW7060, SW7471, SW7740, SW8310, E218.6, SW1311/SW6010[k], SW1311/SW7060[k], SW1311/SW7471[k], SW1311/SW7740[k] (35-45') FGC	(15') ModSW8015/3550, ModSW8015/5030, SW8080, SW8280, SW8270, SW6010, SW8310, SW9012, SW7060, SW7471, SW7740, SW1311/SW6010[k], SW1311/SW7060[k], SW1311/SW7471[k], SW1311/SW7740[k] (15-25') FGC (35-45') FGC	(15-25') FGC (35-45') FGC (55-65') FGC (75-85') FGC (90-100') FGC (groundwater) SW8260[d,j], SW6010D, SW8270, SW7060D, SW7421D, SW7740D, SW7470D	(10' in fill above waste) ModSW8015/3550, ModSW8015/5030, SW8270, SW6010, SW7060, SW7471, SW7740 (15-25') FGC, TO-14 (30') ModSW8015/3550, ModSW8015/5030, SW8270, SW8080, SW8280, SW9012, SW9045, SW6010, SW7060, SW7471, SW7740, SW1311/SW6010[k], SW1311/SW7060[k], SW1311/SW7471[k], SW1311/SW7740[k] (35-45') FGC	(10-20' in waste) ModSW8015/3550[a], SW8270[a], SW8080[a], SW8280[a], SW9012[a], SW9045[a], SW6010, SW7060, SW7471, SW7740, ModSW8015/5030, SW8310[a], E218.6[e] (15-25') FGC (30') ModSW8015/3550, ModSW8015/5030, SW8270, SW8080, SW8280, SW9012, SW9045, SW6010, SW7060, SW7471, SW7740, SW8310, E218.6[e], SW1311/SW6010[k], SW1311/SW7060[k], SW1311/SW7471[k], SW1311/SW7740[k] (35-45') FGC

(Continued)

TABLE 5.13-3. (Continued)

Location:	Tank 701	Tank 712	Firing Range		Ditch South of PRL 8	Don Julio Creek
Potential Contaminant of Concern:	Petroleum hydrocarbons-diesel, VOCs	Petroleum hydrocarbons-diesel, VOCs	Total and Soluble Lead, Copper		Aluminum	TPH, SVOCs, Inorganic species
Sampling Location:	Boring SB15	Boring SB16	Sediment Sample MS1	Hand Augers HA1–HA5	Hand Auger HA6–HA8	Sediment Samples MC1[f], MC2[f]
Sample Depth and Analytical Method:	(10′) ModSW8015/3550 (15–25′) FGC (20′) ModSW8015/3550 (35–45′) FGC (30′) ModSW8015/3550	(10′) ModSW8015/3550 (15–25′) FGC (20′) ModSW8015/3550 (35–45′) FGC (30′) ModSW8015/3550	(0–0.25′)[g] SW6010T/D[h]	(0–0.25′)[f,g] SW6010T/D[h] (3′)[f,g] SW6010T/D[h], SW8270[i]	(0-0.25′) SW6010 (5′) SW6010	(0–0.25′) ModSW8015/3550, SW8270, SW6010

[a] 4:1 composite samples. Samples will be composited between 10′ and 20′, and 20′ and 30′.
[b] SB5 and SB6 only.
[c] Four samples will be collected in each boring (SB3 and SB14) for bulk density analysis (ASTM 2937) in different soil types.
[d] Analyzed for SW8240 analytes.
[e] SB10 and SB11 only.
[f] 5:1 composite samples.
[g] Samples will be sifted to remove bullets before they are placed in sample containers.
[h] Analyzed for copper and total and soluble lead only.
[i] HA1 and HA3 only.
[j] The benefits and limitations of Method SW8260 are currently being compared with Methods SW8010 and SW8020. Depending on the outcome of this review, Methods SW8010 and SW8020 may be used instead of SW8260.
[k] The sample yielding the highest concentration of inorganic constituents relative to the constituent's toxicity (see Section 4.3.2) in both CS 7 and PRL 8 will be analyzed for soluble metal concentrations.

FGC = Screening analysis of soil gas for commonly detected VOCs with on-site chromatograph.

NOTE: Matrix represents the minimum number of samples to be collected in each horizon.
FGC analyses will be confirmed with 10% TO-14 analysis.
Specific sample depths will be determined in the field using the sampling criteria specified in Section 4.
All acronyms are defined on the acronym list at the beginning of the ′ ′

TABLE 5.13-4. SAMPLING AND FIELD SPECIFICATIONS FOR IC 21

Boring/Location Name	Reference Point	Distance	Maximum Depth Interval (ft BGS)
Hand Auger			
HA1	Northeast corner of Bldg. 710	15'S, 150'W	3
HA2	Northeast corner of Bldg. 710	111'N, 47'E	3
HA3	Northeast corner of Bldg. 710	145'N, 0'E	3
HA4	Northwest corner of Bldg. 710	107'N, 6'E	3
HA5	Northeast corner of Bldg. 710	167'N, 185'E	3
HA6	MW-189	58'S, 388'E	5
HA7	MW-189	59'S, 270'E	5
HA8	MW-189	55'S, 329'E	5
Borings			
SB1	Northernmost corner of Bldg. 710	28'S, 247'E	100
SB2	MW-189	59'S, 237'W	100
SB3	MW-189	71'S, 248'E	100
SB4	North corner of Bldg. 701	296'N, 109'E	45
SB5	North corner of Bldg. 701	182'N, 183'E	45
SB6	North corner of Bldg. 701	74'N, 125'E	45
SB7	North corner of Bldg. 701	17'S, 138'E	45
SB8	364,300 N, 2,167,850 E	64'N, 73'E	45
SB9	364,300 N, 2,167,850 E	71'S, 121'E	100
SB10	364,100 N, 2,168,200 E	22'N, 170'W	45
SB11	364,300 N, 2,167,850 E	40'N, 176'E	45
SB12	364,300 N, 2,167,850 E	93'S, 237'E	45
SB13	364,300 N, 2,167,850 E	206'S, 271'E	45
SB14	364,300 N, 2,167,850 E	246'N, 197'E	100
SB15	Northernmost corner of Bldg. 701	33'S, 30'E	45
SB16	Southernmost corner of Bldg. 712	3'N, 74'W	45
Surface Scrapes			
MC1	Northernmost corner of Bldg. 710	69'N, 164'W	0.25
MC2	Northwest corenr of Bldg. 712	330'S, 58'W	0.25
MS1	Northernmost corner of Bldg. 710	91'N, 45'E	0.25

5.14 Field Sampling Plan for Potential Release Location (PRL) 53

Potential Release Location 53 is located in the center of Operable Unit (OU) C and was a settling pond in the 1950s. Currently, PRL 53 consists of Building 704, an access apron, a concrete taxiway, and surrounding grass and dirt areas (Figure 5.14-1).

Building 704 is used for maintenance and repair of aircraft. There are three unpaved areas north of the Building 704, each with stormwater drains. These areas have been graded to direct runoff to the drains. Fuel spills reportedly occurred at Building 704 (CH2M HILL, 1993). Historically, the general practice in the event of a spill was reportedly to wash the material into the storm drains. Chemicals used in Building 704 include toluene, 1,1,1-trichloroethane, formaldehyde, and phenols. Radar vans containing polychlorinated biphenyls (PCB) transformers were reportedly serviced at Building 704 (CH2M HILL, 1993), although this report could not be verified (Jeffrey, 1993). An industrial wastewater line (IWL) runs from Building 704 south/southwest to the Industrial Wastewater Treatment Plant (IWTP) in IC 14.

During the 1950s, a settling pond was located east of Patrol Road. It is visible on aerial photographs taken in the late 1950s. It is unknown what the settling pond was used for. Building 704 was constructed in 1960 and was built over the southern portion of the settling pond. The northern portion of the settling pond was covered with soil.

Historical aerial photographs indicate a firing range was located along the western boundary of PRL 53. The firing range was built sometime before 1946 and demolished between 1957 and 1959, prior to construction of Building 704. The firing range consisted of a building and a 120-foot long by 40-foot wide dirt mound used as a backstop.

Previous investigations at PRL 53 are summarized in Table 5.14-1.

5.14.1 Data Quality Objectives

The data quality objectives for this stage of the PRL 53 remedial investigation (RI) are shown on Table 5.14-2.

5.14.2 Sampling Plan

Proposed sampling locations are shown on Figure 5.14-2. Overlay A shows previous sampling locations. Potential contaminants of concern and the sampling and analytical matrix for PRL 53 are shown in Table 5.14-3; field specifications for sampling locations are included in Table 5.14-4.

Seven borings (SB1 through SB7) are proposed in PRL 53. Four of these borings (SB4–SB7) were placed adjacent to the stormwater drains north of Building 704 to determine if contaminants (including PCBs in soil) from spills and/or leaks have contaminated the surface and subsurface soil and soil gas.

One boring (SB3) will be drilled and sampled to groundwater adjacent to the IWL on the northwest corner of Building 704. Samples were collected along the IWL south of this boring during the OU C1 RI. This boring will help determine if leaks from the IWL have contaminated the subsurface soil/soil gas and the extent of the contamination originating from OU C1 to the south.

Two of the borings (SB1 and SB2) were placed in the northern portion of the

settling pond location to determine if materials stored in the pond may have contaminated subsurface soil or soil gas. Borings SB4 and SB5 are within the southern portion of the pond and will also be used to determine if contamination from the former pond is present. (Although Boring SB3 is within pond boundaries, data from this boring will be used primarily to determine if the IWL is leaking or has leaked at this location.)

Five surface scrapes (SS1 through SS5) will be placed in the dirt areas where the stormwater drains are located. Soil samples collected from these locations will help determine if spills (including PCB spills) have contaminated near-surface soils.

One hand auger (HA1) will be placed at the former location of the firing range backstop (as determined from aerial photographs) to determine if lead and copper contamination is present in the soil. Samples will also be analyzed for semivolatile organic compounds (SVOCs) (SVOCs have been reported in samples from firing ranges at other Department of Defense facilities). Soil samples collected for inorganic analysis will be sifted to remove any bullets or shot prior to the soil being placed in the sampling container.

One composite sediment sample (MC1) will be collected from Don Julio Creek where the stormwater line discharges into the creek. The creek is lined in this area. The sample will help determine if creek sediments are contaminated.

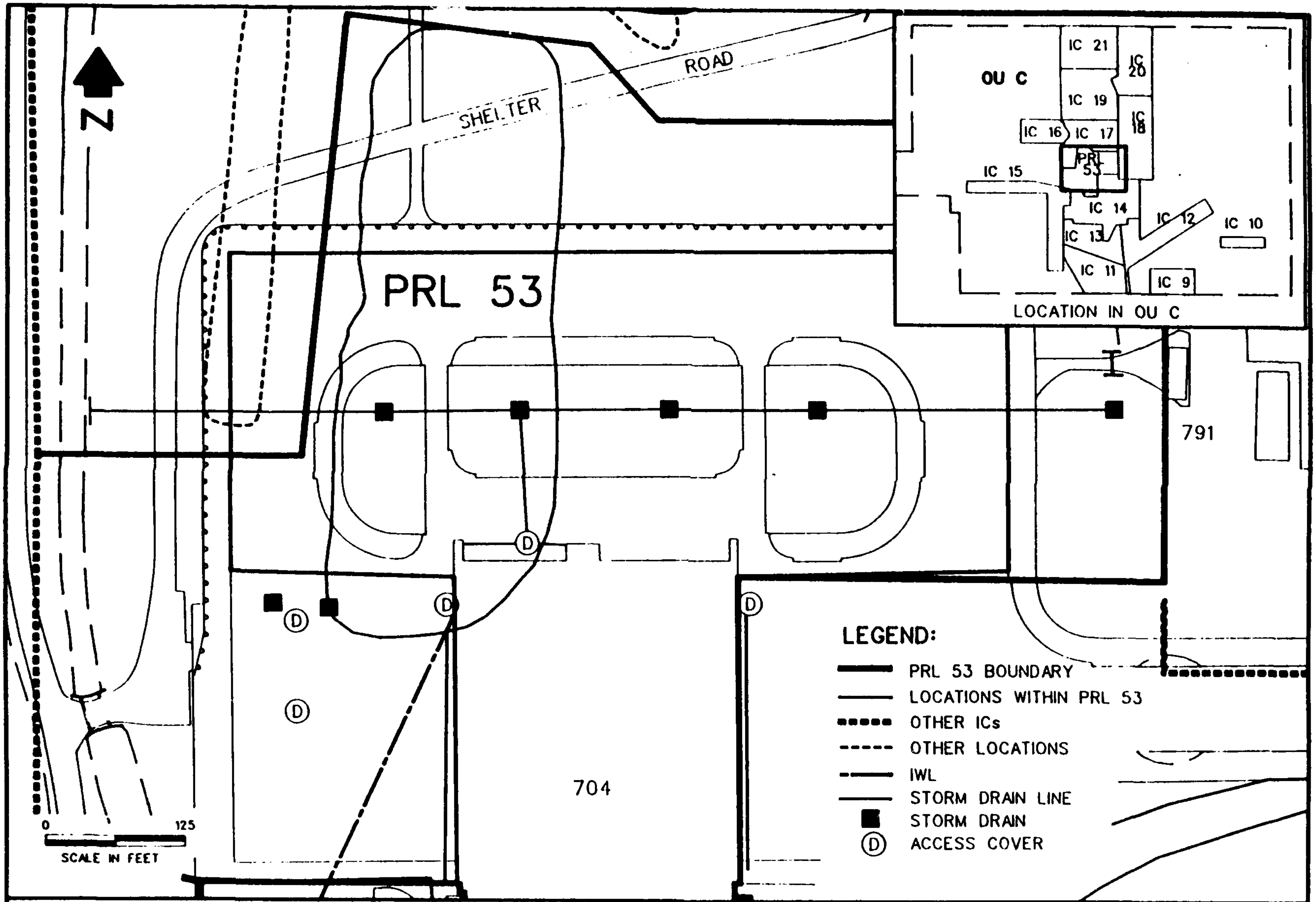


Figure 5.14-1 Potential Discharge Areas in PRL 53

OUC3 PRL53PDA SAC 9/21/93

TABLE 5.14-1. PREVIOUS INVESTIGATIONS AT PRL 53

Year, Contractor	Scope of Investigation	Key Findings
1958, U.S Army Corp of Engineers	Drilled exploratory hole as part of the construction of Building 704 and the taxiway.	Debris and burned material were identified in boring south of Building 704. The area is being investigated as part of PRL 41 in OU C1.
1985, McLaren Environmental Engineers	Investigation of potential contamination at PRL 53. Four auger profile borings and three waste sample borings were drilled and sampled.	VOCs in soil gas were detected with a PID and ranged from 2 to 200 ppmv. VOCs in soil were reported at 20, 30, and 60 feet BGS.
1990, CH2M HILL	Performed a records review of soil sampling performed at Building 704.	Concentrations of TCE (200 $\mu g/kg$), beryllium (0.6 mg/kg), copper (111 mg/kg), mercury (2.2 mg/kg), lead (342 mg/kg), silver (2.6 mg/kg), and thallium (25 mg/kg) were reported in soil samples; however, the date, location, and depth of samples collected are unknown.
1993, CH2M HILL	Preliminary Assessment of sites and locations in OU C.	Identified areas to be investigated in OU C through records review, site visits, and interviews with base personnel.

NOTE: Acronyms are defined in the acronym list at the beginning of this SAP.

TABLE 5.14-2. DATA QUALITY OBJECTIVES FOR AREA NORTH OF BUILDING 704 AT PRL 53

Problem Statement Fuel and hydraulic oil may have been washed onto exposed soil north of Building 704.
Decision to be Made • Determine if the exposed surface soil areas north of Building 704 are contaminated. • Determine if contaminants have migrated to the subsurface. • Determine the locations priority.
Inputs to the Decision Level II and III data for soil gas; Level III for SVOCs, PCB, TPH, and inorganic constituents.
Boundaries of the Study Soil gas samples from 20 to 40 feet BGS and soil samples from surface to 10 feet BGS.
Decision Rule • If organic compounds are reported in the soils, then the soils may have been contaminated from activities at the location. • If inorganic species are reported above background concentrations, then soil may be contaminated and the decision process for inorganic constituents should be applied. • If VOCs are reported in soil gas and if concentrations are greater than adjacent or surrounding borings, the contamination has most likely originated at this location. • If all data are validated, proceed to the Data Evaluation DQOs (see Section 4.2.2).
Limits on Uncertainty Analytical data must meet project specifications for precision and accuracy.
Sample Design Four soil borings (SB4-SB7) will be placed next to storm drains. Surface scrapes (SS1-SS5) will be placed in exposed soil areas.

(Continued)

TABLE 5.14-2. (Continued)

DATA QUALITY OBJECTIVES FOR FORMER SETTLING POND AT PRL 53

Problem Statement The contents and use of the former settling pond are unknown.
Decision to be Made • Determine if contaminants are present in the former settling pond. • Determine the location priority.
Inputs to the Decision Level II/III data for soil gas; Level III for inorganic constituents, SVOCs, and TPH in soil.
Boundaries of the Study Soil gas samples from 20 to 40 feet BGS and soil samples from 5 to 10 feet BGS collected within the settling pond boundaries. (Since this area has been graded and disturbed since the pond was present, surface and near surface soil samples collected in SB4 and SB5 will be used for data interpretation in the area north of Building 704.)
Decision Rule • If organic compounds are reported in the soils, then the soils may have been contaminated from activities at the location. • If inorganic species are reported above background concentrations, then soil may be contaminated and the decision process for inorganic constituents should be applied. • If VOCs are reported in soil gas and if concentrations are greater than adjacent or surrounding borings, the contamination has most likely originated at this location. • If all data collected are validated, proceed to Data Evaluation DQOs (see Section 4.2.2).
Limits on Uncertainty Analytical data must meet project specifications for precision and accuracy.
Sample Design Borings SB1, SB2, SB4, and SB5 will be drilled in the former pond location.

(Continued)

TABLE 5.14-2. (Continued)

DATA QUALITY OBJECTIVES FOR THE IWL AT PRL 53

Problem Statement

Wastewater in the IWL may have leaked and contaminated the subsurface.

Decision to be Made

- Determine if VOCs have leaked from the IWL and contaminated the soil gas and/or the groundwater.
- Determine the location priority.

Inputs to the Decision

Level II/III data for VOCs in soil gas; Level III data for groundwater.

Boundaries of the Study

Soil gas samples will be collected from 20 to 100 feet; a groundwater HydroPunch® sample will be collected.

Decision Rule

- If VOCs are reported in soil gas, and if concentrations increase with distance from other borings drilled to the south along the IWL, then the VOC contamination most likely originates near that location.
- If VOC soil gas concentrations are highest near the bottom of the boring, then this is most likely due to smear zone contamination from OU C1.
- If suites of VOCs in deep soil gas (40 to 60 feet BGS) are the same as in shallow soil gas (10 to 20 feet BGS), then VOCs from the IWL have most likely migrated vertically.
- If all data collected are validated, proceed to Data Evaluation DQOs (see Section 4.2.2).

Limits on Uncertainty

Analytical data must meet project specifications for precision and accuracy.

Sample Design

Boring SB3 will be drilled adjacent to the IWL junction with Building 704 and adjacent to the edge of the aircraft apron.

(Continued)

TABLE 5.14-2. (Continued)

DATA QUALITY OBJECTIVES FOR DON JULIO CREEK AT PRL 53

Problem Statement

Contaminants from PRL 53 may have contaminated sediments.

Decision to be Made

- Determine if contaminants from PRL 53 have contaminated sediments in Don Julio Creek.

Inputs to the Decision

Level III data for SVOCs, TPH, and inorganic constituents in sediments.

Boundaries of the Study

Sediment samples collected at 0.25 feet where stormwater line discharges into Don Julio Creek.

Decision Rule

- If organic compounds are reported in sediment samples, then sediments are contaminated.
- If inorganic species are reported above background concentrations, then sediments may be contaminated and the decision process for inorganic constituents should be applied.
- If all data collected are validated, proceed to Data Evaluation DQOs (see Section 4.2.2).

Limits on Uncertainty

Analytical data must meet project specifications for precision and accuracy.

Sample Design

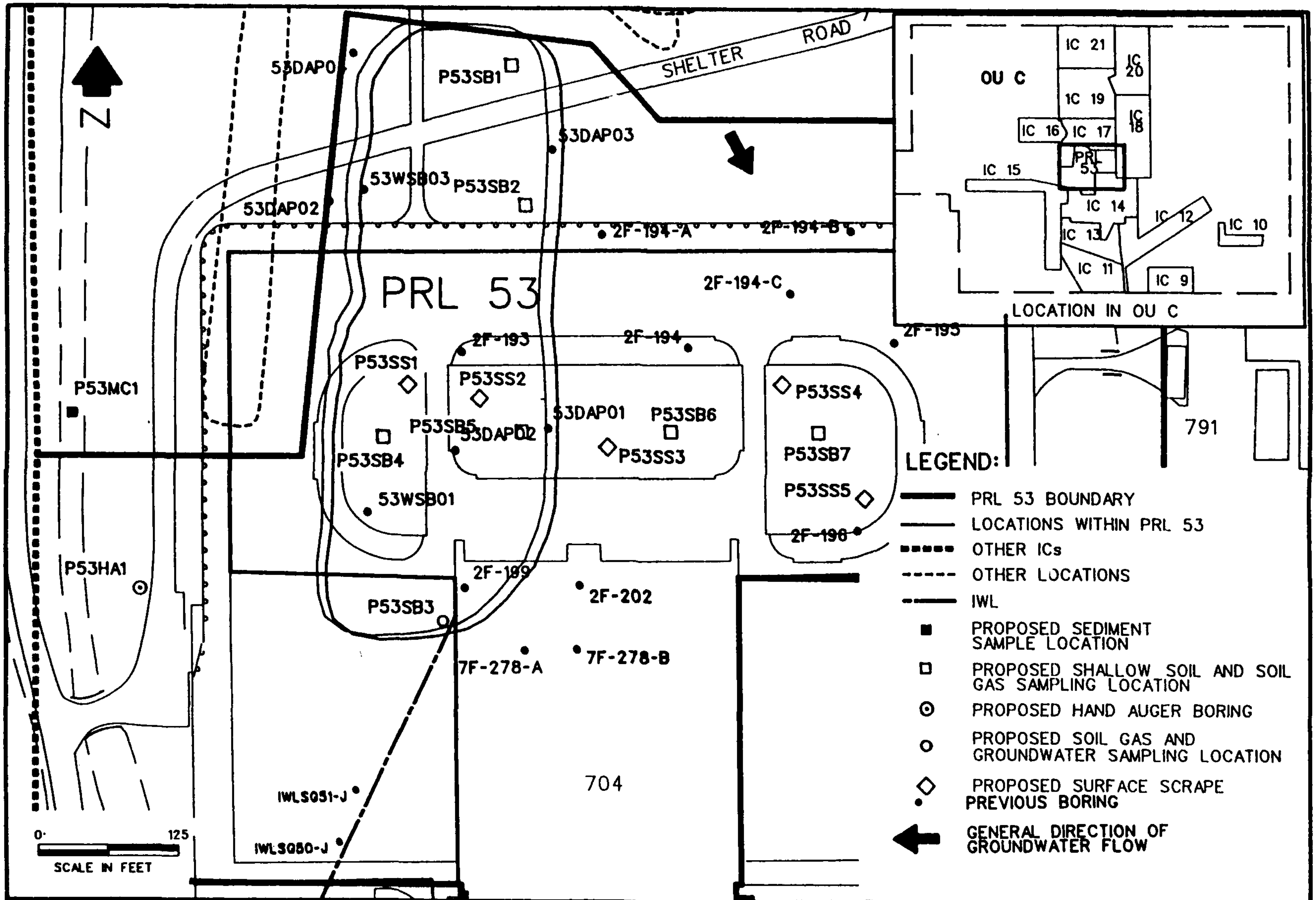
One sample (MC1) will be placed where the stormwater line discharges into Don Julio Creek.

(Continued)

TABLE 5.14-2. (Continued)

DATA QUALITY OBJECTIVES FOR FORMER FIRING RANGE AT PRL 53

Problem Statement Lead, copper, and semivolatile organic contamination from the former firing range may have contaminated the soils.
Decision to be Made • Determine if contamination is present in the soil. • Determine the location priority.
Inputs to the Decision Level III data for inorganic constituents and SVOCs in soil.
Boundaries of the Study Soil sample from 3 to 5 feet BGS beneath the former backstop.
Decision Rule • If inorganic species are reported above background concentrations, then soil may be contaminated and the decision process for inorganic constituents should be applied. • If all data collected are validated, proceed to Data Evaluation DQOs (see Section 4.2.2).
Limits on Uncertainty Analytical data must meet project specifications for precision and accuracy.
Sample Design One hand auger (HA1) will be placed in the area of uncovered soil where the former backstop was located (as determined by aerial photographs).



Overlay A. Previous Sampling Locations

Figure 5.14-2 Proposed Sampling Locations in PRL 53

OUC4 PRL53PSL SAC 02/23/94

TABLE 5.14-3. SAMPLING AND ANALYSIS MATRIX FOR PRL 53

Location	PRL 53 (Former Settling Pond)	Area North of Building 704			IWL	Former Firing Range	Don Julio Creek
Contaminant of Concern:	Unknown	VOCs, SVOCs, Inorganics, TPH, PCBs			VOCs	Total and Soluble Lead and Copper, SVOCs	SVOCs, Inorganics, TPH
Sampling Location:	Borings SB1–SB2	Borings SB4[a] and SB5[a]	Borings SB6 and SB7	Surface Scrapes SS1–SS5	Borings SB3[b]	Hand Auger HA1	Sediment Sample MC1
Depth and Analytical Method:	(5') SW6010, ModSW8015/3550, SW8270 (10') SW6010, ModSW8015/3550, SW8270 (15–25') FGC (35–45') FGC	(0-0.25') SW6010, ModSW8015/3550, SW8080 (1') SW8270 (5') SW6010, ModSW8015/3550, ModSW8015/5030, SW8270 (10') ModSW8015/3550, ModSW8015/5030, SW6010, SW8270 (15-25') FGC (35-45') FGC	(0-0.25') SW6010, ModSW8015/3550, SW8080 (1') SW8270 (5') SW6010, ModSW8015/3550, ModSW8015/5030, SW8270 (15-25') FGC	(0-0.25') ModSW8015/3550, SW8080, SW6010 (1') SW8270	(15-25') FGC (35-45') FGC (55-65') FGC (75-85') FGC (90-100') FGC (groundwater) SW8260[d]	(3') SW6010T/D[c], SW8270 (5') SW6010T/D[c], SW8270	(0-0.25') SW6010, ModSW8015/3550, SW8270

(Footnotes presented on following page.)

TABLE 5.14-3. (Continued)

[a] Boring will also be used to characterize contamination in the settling pond.
[b] Three samples will be collected in different soil types for bulk density analysis (ASTM 2937).
[c] Analyzed for total and soluble copper and lead only.
[d] The benefits and limitations of Method SW8260 are currently being compared with Methods SW8010 and SW8020. Depending on the outcome of this review, Methods SW8010 and SW8020 may be used instead of SW8260.

FGC = Screening analysis of soil gas for commonly detected VOCs with on-site chromatograph.

NOTE: Matrix represents the minimum number of samples to be collected in each horizon.
FGC analyses will be confirmed with 10% TO-14 analysis.
Specific sample depths will be determined in the field using the sampling criteria specified in Section 4.
All acronyms are defined on the acronym list at the beginning of the SAP.

TABLE 5.14-4. SAMPLING AND FIELD SPECIFICATIONS FOR PRL 53

Boring/Location Name	Reference Point	Distance	Maximum Depth Interval (ft BGS)
Sediment Samples			
MC1	Northwest corner of Bldg. 704	112'N, 342'W	0.25
Surface Scrapes			
SS1	Northwest corner of Bldg. 704	138'N, 42'W	1
SS2	Northwest corner of Bldg. 704	126'N, 20'E	1
SS3	Northwest corner of Bldg. 704	83'N, 135'E	1
SS4	Northwest corner of Bldg. 704	140'N, 292'E	1
SS5	Northwest corner of Bldg. 704	39'N, 367'E	1
Hand Augers			
HA1	Northwest corner of Bldg. 704	45'S, 261'W	5
Borings			
SB1	Northwest corner of Bldg. 704	422'N, 49'E	45
SB2	Northwest corner of Bldg. 704	296'N, 62'E	45
SB3	Northwest corner of Bldg. 704	71'S, 10'W	100
SB4	Northwest corner of Bldg. 704	91'N, 65'W	45
SB5	Northwest corner of Bldg. 704	97'N, 58'E	45
SB6	Northwest corner of Bldg. 704	98'N, 193'E	25
SB7	Northwest corner of Bldg. 704	97'N, 325'E	25

5.15 Field Sampling Plan for Potential Release Location (PRL) S-10

Potential Release Location S-10 is the location of a hazardous and radioactive waste storage yard at Facility 1086. The facility was constructed in 1973 and is located in Operable Unit (OU) E (Figure 5.15-1). This location will be included in the OU C remedial investigation at the request of the regulatory agencies.

A small (12 foot by 15 foot) galvanized steel building and two temporary storage buildings are currently located at PRL S-10; they are used to store low-level radioactive waste. The galvanized steel building has been in use since 1974. The two temporary storage buildings are visible at PRL S-10 in a 1990 aerial photograph. Both hazardous and radioactive wastes were stored at PRL S-10, including volatile organic compounds (VOCs), polychlorinated biphenyls (PCBs), inorganic species, acids, cyanide sludge, heavy metal sludge, paints, and other wastes. All other hazardous wastes were removed in 1982, and currently only radioactive wastes remain. With the exception of the OU C Preliminary Assessment (PA) (CH2M HILL, 1993), no previous investigations have been conducted at PRL S-10.

5.15.1 Data Quality Objectives

The data quality objectives for this phase of the Remedial Investigation (RI) at PRL S-10 are shown on Table 5.15-1.

5.15.2 Sampling Plan

Proposed sampling locations are shown on Figure 5.15-2. Potential contaminants of concern and the sampling and analysis matrix for PRL S-10 are shown in Table 5.15-2; field specifications for sampling locations are included in Table 5.15-3.

Rationale and specific objectives for sampling locations are outlined below.

Field measurements will be made at PRL S-10 and its adjacent surface depressions and drainage ditch using a Geiger-Mueller counter and a 2-inch by 2-inch sodium iodide probe to identify areas of radionuclide contamination. The location will be screened with the Geiger-Mueller counter by traversing the location in a north-south and east-west direction with 3-foot spacing between traverses. As areas of increased radioactivity are detected, surface spill or leak boundaries will be delineated using a pancake probe (in direct contact with the soil). Contamination will be documented (Level III data) using a chart recorder.

Hand augers (HA1–HA4) will be drilled in each area of increased radioactivity (additional sample number designations will be added if necessary). Hand auger samples will be analyzed by an off-site laboratory to speciate the identified radiation and determine if radionuclide contamination has migrated vertically in the soil. Concentrations in these hot spots will be defined to 3 feet BGS in Phase 1.

Twenty-five surface scrape (SS1–SS25) and two drainage ditch samples (MS1 and MS2) will be collected and screened by immunoassay analysis to identify PCB contamination at PRL S-10, its adjacent surface depressions, and the drainage ditch.

Hand augers (HA5–HA8) will be drilled at any surface scrape location yielding an immunoassay result of 5 milligrams per kilogram (mg/kg) or greater (sample number

designations will be added or deleted as necessary). Samples will confirm the immunoassay results at the surface, determine vertical extent of PCB contamination that is 50% or more of the likely cleanup goal of 10 mg/kg, and determine if dioxins and/or furans are present at these locations. The extent will be defined to 3 feet BGS since these compounds typically do not migrate vertically.

Contaminants of concern (COCs) in addition to the standard suite listed on Table 4-11 of Section 4.3.2 include cyanide, acids, and bases (cyanide sludge and acids were stored at PRL S-10). Soil from 13 of the surface scrape locations will be analyzed for these additional COCs plus semivolatile organic compounds and inorganic species to identify areas where spills or leaks may have contaminated the surface.

Boring SB1 will be placed in the center of PRL S-10 (Figure 5.15-2) and will be drilled to groundwater to determine if soil, soil gas, and/or groundwater contamination is present. Radionuclide contamination will be defined to 20 feet BGS. Deeper samples will be analyzed for radionuclides only if shallower samples contain concentrations above background. Deep samples will be held in the laboratory until results from shallow samples are available.

Boring SB1 will be converted to a groundwater monitoring well (as recommended in the OU C PA [CH2M HILL, 1993]) to help define groundwater quality and flow directions in this area. Currently there are no monitoring wells in this area of McClellan AFB, and the quality of groundwater and direction of flow are unknown.

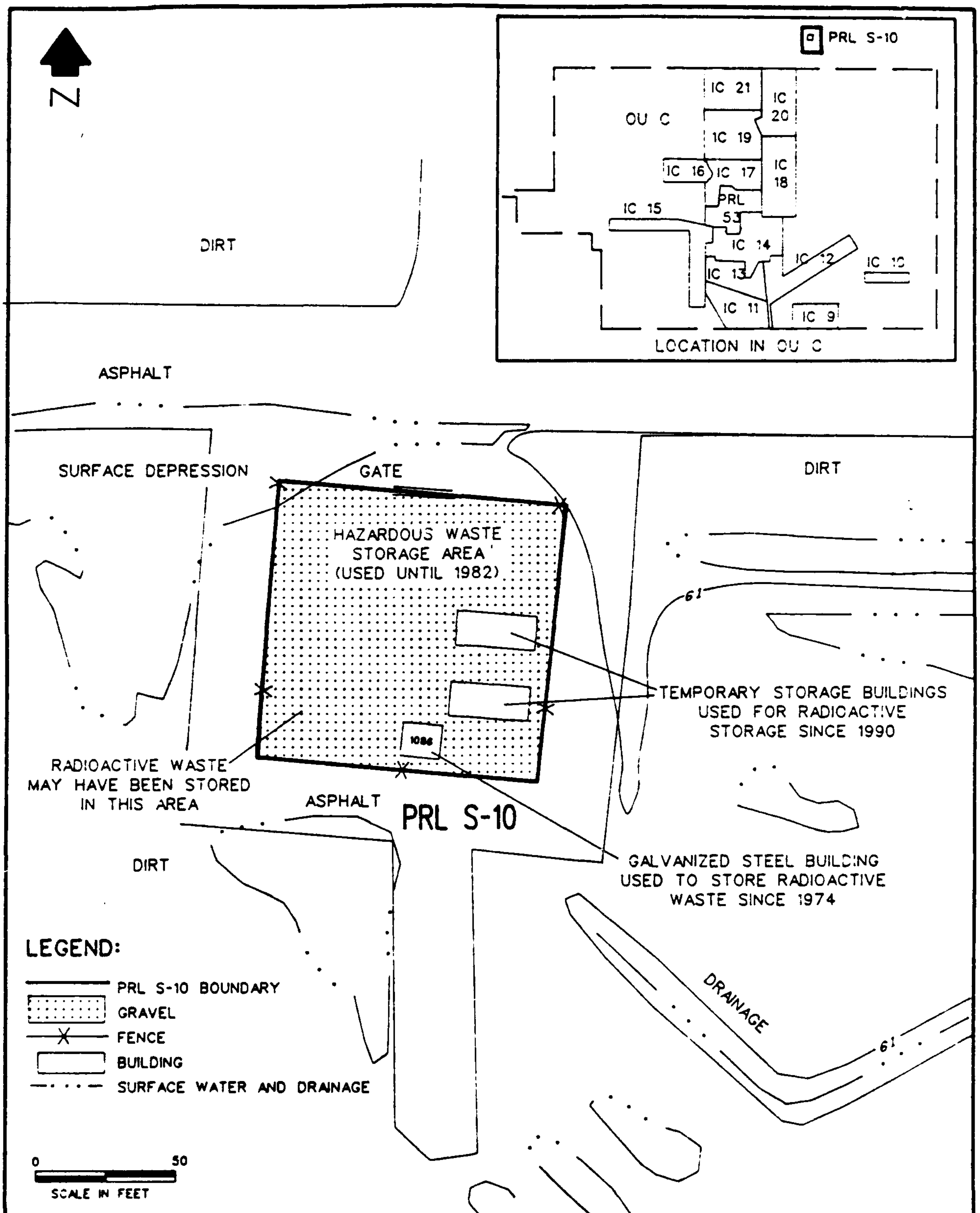


Figure 5.15-1 Potential Discharge Areas at PRL S-10

OUC1 S10PDA2 SAC 9/7/93

TABLE 5.15-1. DATA QUALITY OBJECTIVES FOR PRL S-10

Problem Statement Drummed hazardous and/or radioactive wastes may have leaked or spilled at PRL S-10.
Decisions to be Made • Determine if the surface and/or subsurface is contaminated. • Determine if contaminants drained to the nearby surface depressions and drainage ditch, contaminating the soils beneath. • Determine the location priority.
Inputs to the Decision Level II/III for VOCs in soil gas; Level II/III for radionuclides and PCBs in the soil; Level III for SVOCs, inorganic species, cyanide, and pH in the soil.
Boundaries of the Study The entire location, drainage ditch, and surface depressions will be screened for radionuclides with a Geiger-Mueller counter. Soil gas samples from approximately 20 to 100 feet BGS will be collected in the center of PRL S-10. Soil samples will be collected from surface to 20 feet BGS.
Decision Rule • If VOCs are reported in soil gas and if concentrations decrease with depth, then the soil gas contamination may originate at this location. • If VOC concentrations are low or not detected in the shallow soil gas (<40 feet BGS), but are reported or increase with depth in the deep soil gas (>40 feet BGS), the soil gas contamination is probably from the smear zone left by declining water levels. • If organic compounds are reported in soil and/or soil gas, then the surface and/or subsurface has been contaminated by spills or leaks of materials stored at the location. • If radionuclides are reported above background in the soil, then radioactive waste spills or leaks may have contaminated the location and the decision process for inorganic constituents should be applied. • If inorganics are reported above background concentrations in soil samples, then spills or leaks at PRL S-10 may have contaminated the location and the decision process for inorganic constituents should be applied. • If organic compounds are reported in the groundwater samples, then the groundwater has been contaminated. • If all data collected are validated, then apply Data Evaluation DQOs (see Section 4.2.2).
Limits on Uncertainty Analytical data must meet project specifications for precision and accuracy.
Sample Design Radionuclide and PCB hot spots will be identified using screening techniques (Geiger-Muller counter and immunoassay tests, respectively). Samples (HA1–HA8) will be collected in areas with elevated concentrations for confirmation and definition of vertical extent. Samples (from SS1–SS25) will be collected across the area for other contaminants of concern. Boring SB1 will be drilled in the center of PRL S-10 to define VOC concentrations in soil gas and the vertical extent of radionuclide contamination. Radionuclide samples in SB1 will be held and analyzed only if shallower samples contain concentrations above background.

(Continued)

TABLE 5.15-1. (Continued)

DATA QUALITY OBJECTIVES FOR GROUNDWATER AT PRL S-10

Problem Statement

There are currently no monitoring wells in the area and the quality of groundwater and flow directions.

Decisions to be Made

- Determine groundwater flow directions.
- Determine if the groundwater beneath PRL S-10 is contaminated.
- Determine the location priority.

Inputs to the Decision

Level III data for groundwater. Previous groundwater flow and contaminant data.

Boundaries of the Study

Soil gas samples from 20 to 100 feet BGS. Groundwater samples from the A monitoring zone.

Decision Rule

- Contaminants from the location have contaminated the groundwater if all of the following are true:
  - Organic compounds or inorganic species above background are reported in groundwater samples from downgradient of the location.
  - Those suites of compounds or species are also reported in soil gas beneath the location, and
  - Those compounds or species are not reported or are reported at lower concentrations in upgradient samples.
- If all data collected are validated, then apply Data Evaluation DQOs (see Section 4.2.2).

Limits on Uncertainty

Analytical data must meet project specifications for precision and accuracy.

Sample Design

Boring SB1 is located in an area of McClellan AFB where no groundwater quality or flow direction data are available. The location was recommended in the OU C PA.

NOTE: All acronyms are defined in the acronym list at the beginning of the SAP.

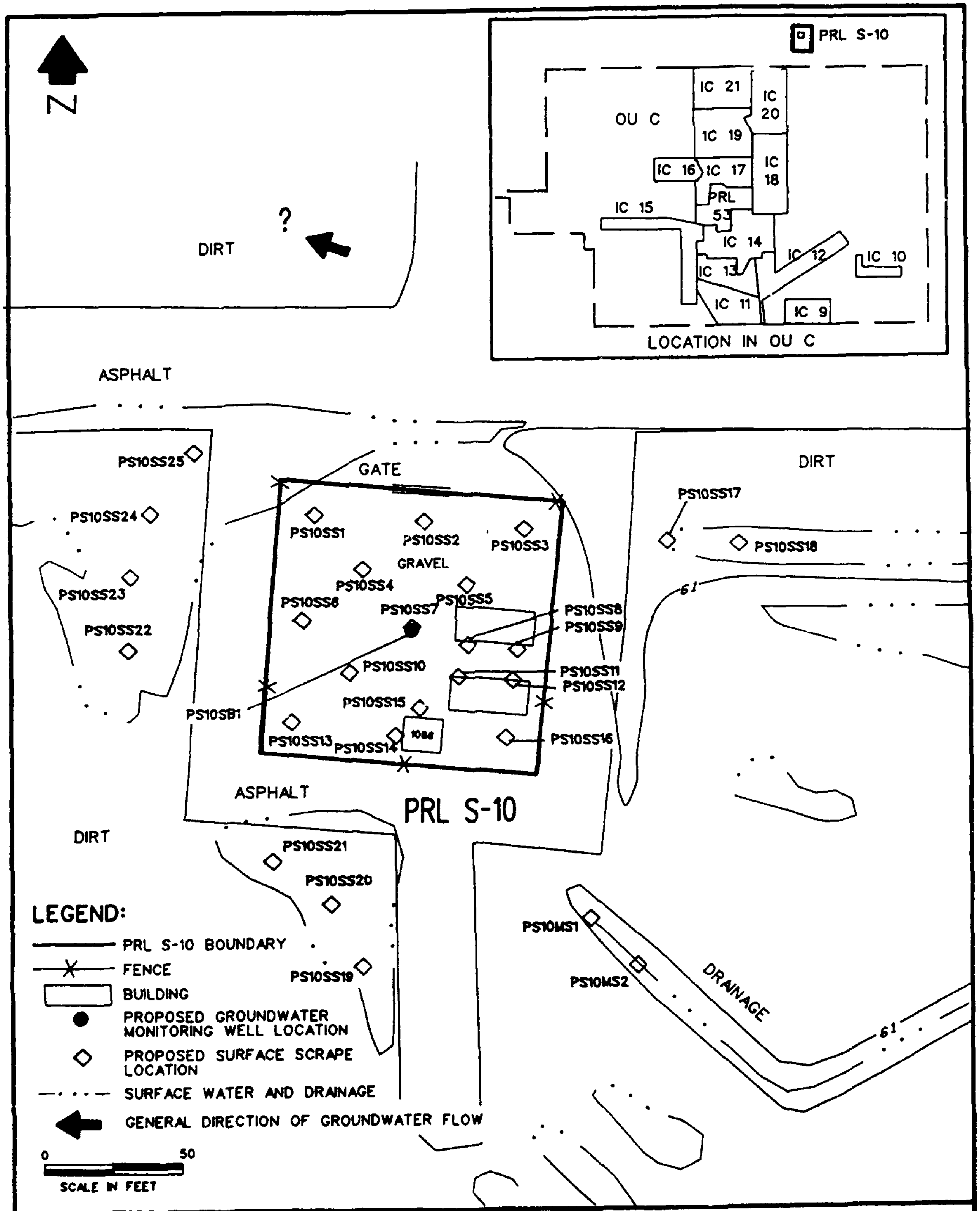


Figure 5.15-2 Proposed Sampling Locations at PRL S-10

OUC4 S10PSL SAC 2/23/94

TABLE 5.15-2. SAMPLING AND ANALYSIS MATRIX FOR PRL S-10

Location:	PRL S-10				
Contaminant of Concern:	Acids, Bases, VOCs, Inorganic species, SVOCs, Cyanide, Radionuclides, PCBs				
Sampling Location:	Boring SB1	Surface Scrapes SS2, SS7, SS8, SS9, SS11, SS12, SS15, SS17, SS21, SS23, SS25, MS1, MS2	Surface Scrapes SS1, SS3-SS6, SS10, SS13, SS14, SS16, SS18-SS20, SS22, SS24	PCB Hand Auger(s)[a] HA5-HA8	Radionuclide Hand Auger(s)[b] HA1-HA4
Depth and Analytical Method:	(1') E901.1, SW9310	(0-0.25') IPCB SW9012, SW9045, SW6010	(0-0.25') IPCB	(0-0.25') SW8080, SW8280	(0-0.25') E901.1, SW9310
	(10') SW9310[c], E901.1[c]	(1') SW8270			
	(15-25') FGC				
	(20') E901.1[c], SW9310[c]			(3') SW8080, SW8280	(3') E901.1, SW9310
	(35-45') FGC				
	(55-65') FGC				
	(75-85') FGC				
	(90-100') FGC				
	(groundwater) SW8260[d]				

(Footnotes presented on following page.)

TABLE 5.15-2. (Continued)

[a] Location of hand auger(s) for PCB analysis will be determined based on immunoassay test results.
[b] Location of hand auger(s) for radionuclide analysis will be determined based on Geiger-Mueller counter results.
[c] Sample will be analyzed only if previous (uphole) sample contains inorganic species above subsurface background concentrations.
[d] The benefits and limitations of Method SW8260 are currently being compared with Methods SW8010 and SW8020. Depending on the outcome of this review, Methods SW8010 and SW8020 may be used instead of SW8260.

IPCB = Immunoassay analysis for PCBs.
FGC = Screening analysis of soil gas for commonly detected VOCs with on-site chromatograph.

NOTE: Matrix represents the minimum number of samples to be collected in each horizon.
FGC analyses will be confirmed with 10% TO-14 analysis.
IPCB analyses will be confirmed with 10% SW8080 analysis.
Specific sample depths will be determined in the field using the sampling criteria specified in Section 4.
All acronyms are defined on the acronym list at the beginning of the SAP.

TABLE 5.15-3. SAMPLING AND FIELD SPECIFICATIONS FOR PRL S-10

Boring/Location Name	Reference Point	Distance	Maximum Depth Interval (ft BGS)
Surface Scrape			
SS1	Northwest corner of Bldg. 1086	74'N, 31'W	0.25
SS2	Northwest corner of Bldg. 1086	71'N, 8'E	1
SS3	Northwest corner of Bldg. 1086	68'N, 44'E	0.25
SS4	Northwest corner of Bldg. 1086	53'N, 14'W	0.25
SS5	Northwest corner of Bldg. 1086	48'N, 22'E	0.25
SS6	Northwest corner of Bldg. 1086	35'N, 36'W	0.25
SS7	Northwest corner of Bldg. 1086	32'N, 2'E	1
SS8	Northwest corner of Bldg. 1086	26'N, 23'E	1
SS9	Northwest corner of Bldg. 1086	16'N, 37'W	1
SS10	Northwest corner of Bldg. 1086	34'N, 16'W	0.25
SS11	Northwest corner of Bldg. 1086	14'N, 19'E	1
SS12	Northwest corner of Bldg. 1086	13'N, 39'E	1
SS13	Northwest corner of Bldg. 1086	1'S, 40'W	0.25
SS14	Northwest corner of Bldg. 1086	6'S, 3'W	0.25
SS15	Northwest corner of Bldg. 1086	3'N, 5'E	1
SS16	Southeast corner of Bldg. 1086	5'N, 24'E	0.25
SS17	Southeast corner of Bldg. 1086	76'N, 83'E	1
SS18	Southeast corner of Bldg. 1086	75'N, 109'E	0.25
SS19	Southeast corner of Bldg. 1086	77'S, 28'W	0.25
SS20	Southeast corner of Bldg. 1086	54'S, 39'W	0.25
SS21	Southeast corner of Bldg. 1086	36'S, 59'W	1
SS22	Northwest corner of Bldg. 1086	25'N, 98'W	0.25
SS23	Northwest corner of Bldg. 1086	52'N, 97'W	1
SS24	Northwest corner of Bldg. 1086	74'N, 90'W	0.25
SS25	Northwest corner of Bldg. 1086	97'N, 74'W	1
Hand Augers			
MS1	Southeast corner of Bldg. 1086	60'S, 54'E	1
MS2	Southeast corner of Bldg. 1086	77'S, 71'E	1
HA1	To be determined	—	3
HA2	To be determined	—	3
HA3	To be determined	—	3
HA4	To be determined	—	3
HA5	To be determined	—	3
HA6	To be determined	—	3
HA7	To be determined	—	3
HA8	To be determined	—	3
Borings			
SB1	Southeast corner of Bldg. 1086	31'N, 2'E	100

5.16 Field Sampling Plan for Tank 761

Tank 761 is a 1,000-gallon diesel fuel tank located near Building 761. Building 761 was operated until recently by the Federal Aviation Administration (FAA), and was not under the control of McClellan Air Force Base (AFB) until the late 1980s. The tank was scheduled to be removed in 1990; however, it is not known whether the tank has actually been removed (CH2M HILL, 1993).

No previous investigations have been performed at Tank 761.

5.16.1 Data Quality Objectives

Data quality objectives for IC 16 are shown on Table 5.16-1.

5.16.2 Sampling Plan

Proposed sampling locations are shown on Figure 5.16-1. Potential contaminants of concern and the sampling and analytical matrix for Tank 761 is shown in Table 5.16-2; field specifications for sampling locations are included in Table 5.16-3.

Before drilling begins, a record search of Civil Engineering construction diagrams will be completed to identify the most appropriate sampling location relative to the tank (or former tank) location.

One boring (SB1) will be drilled to determine if diesel has leaked from the tank into the subsurface. In addition to soil samples, soil gas samples will be collected to determine if contaminants other than diesel are present which may effect selection of remedial alternatives.

TABLE 5.16-1. DATA QUALITY OBJECTIVES FOR TANK 761

Problem Statement Diesel fuel in the tank may have leaked and contaminated the subsurface.
Decision to be Made • Determine if leaks in the tank or piping have contaminated the subsurface. • Determine the location priority.
Inputs to the Decision Level II/III for soil gas; Level III data for TPH in soil.
Boundaries of the Study Soil and soil gas samples from approximately 10 to 40 feet BGS.
Decision Rule • If petroleum hydrocarbons are reported in the soil adjacent to and/or beneath the tank, leaks from the tank have contaminated the subsurface. • If all data collected are validated, proceed to the Data Evaluation DQOs (see Section 4.2.2).
Limits on Uncertainty Analytical data must meet project specifications for precison and accuracy.
Sample Design Boring SB1 will be placed adjacent to estimated location of the tank as determined from Civil Engineering construction diagrams.

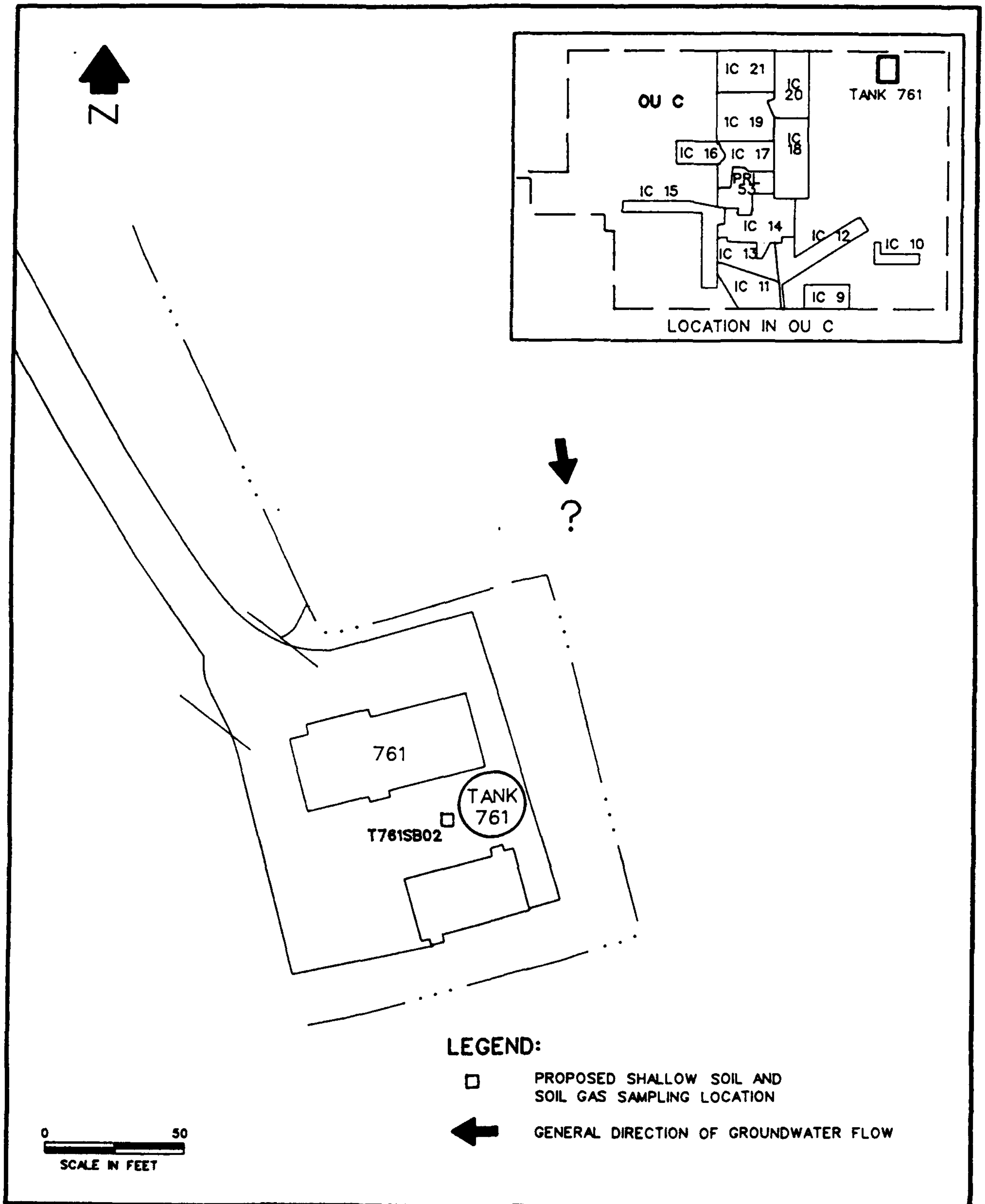


Figure 5.16-1. Proposed Sampling Locations at Tank 761

OUC4 T761SAC 2/23/94

TABLE 5.16-2. SAMPLING AND ANALYTICAL MATRIX FOR TANK 761

Location:	Tank 761 — 1,000-gallon diesel tank
Potential Contaminants of Concern:	VOCs, TPH (diesel)
Sample Location:	Boring SB1
Sample Depth and Analytical Method:	(10′) ModSW8015/3550 (15–25′) FGC (20′) ModSW8015/3550 (30′) ModSW8015/3550 (35-45′) FGC

FGC = Screening analysis of soil gas for commonly detected VOCs with on-site chromatograph.

NOTE:
- Matrix represents the minimum number of samples to be collected in each horizon.
- FGC analyses will be confirmed with 10% TO-14 analysis.
- Specific sample depths will be determined in the field using the sampling criteria specified in Section 4.
- All acronyms are defined on the acronym list at the beginning of the SAP.

TABLE 5.16-3. SAMPLING AND FIELD SPECIFICATIONS FOR TANK 761

Boring/Location Name	Reference Point	Distance	Maximum Depth Interval (ft BGS)
Borings			
SB1	Southeast corner of Bldg. 761	19'S, 12'W	45

5.17 Field Sampling Plan for Tanks 783 and 788

Tanks 783 and 788 are located between Building 788 and Bays M and N of Building 783 just west of the oxidation ponds (Potential Release Location [PRL] 60).

Tank 783 is a 1,000-gallon waste fuel tank located near Building 783 (Figure 5.17-1). It was installed in 1957 and removed in 1989 (CH2M HILL, 1993). It is unknown how activities in Building 783 may have contributed waste fuel to Tank 783.

Tank 788, a small acid neutralization sump installed in the late 1980s, is located adjacent to the southwest corner of Building 788 (Figure 5.17-1). This sump is underground and is currently in use; however, it is not considered an underground storage tank (UST) by the County of Sacramento Health Department. The capacity of this small sump is unknown.

With the exception of the Operable Unit (OU) C Preliminary Assessment (PA) (CH2M HILL, 1993), no previous investigations have been conducted at either of these tanks.

5.17.1 Data Quality Objectives

The data quality objectives for this phase of the Remedial Investigation (RI) at Tanks 783 and 788 are shown on Table 5.17-1.

5.17.2 Sampling Plan

Proposed sampling locations are shown on Figure 5.17-1. Potential contaminants of concern and the sampling and analysis matrix for Tank 783 and Tank 788 is shown in Table 5.17-2; field specifications for sampling locations are included in Table 5.17-3.

Before sampling begins, a record search of Civil Engineering construction diagrams will be completed to identify the most appropriate sampling locations relative to each tank (or former tank) location. A magnetic and electromagnetic geophysical survey may be conducted at Tank 788 if the record search is unsuccessful.

Rationale and specific objectives for sampling locations are outlined below.

One boring (T783SB01) will be drilled in the former location of Tank 783. The boring will be drilled to approximately 20 feet below the bottom of the former tank location; both soil and soil gas will be sampled to determine if contaminants leaked into the subsurface.

One boring will be drilled and sampled at Tank 788 (T[illegible]8SB01) to determine if contaminants have leaked from the tank to the subsurface. The boring will be drilled to approximately 20 feet below the bottom of the tank.

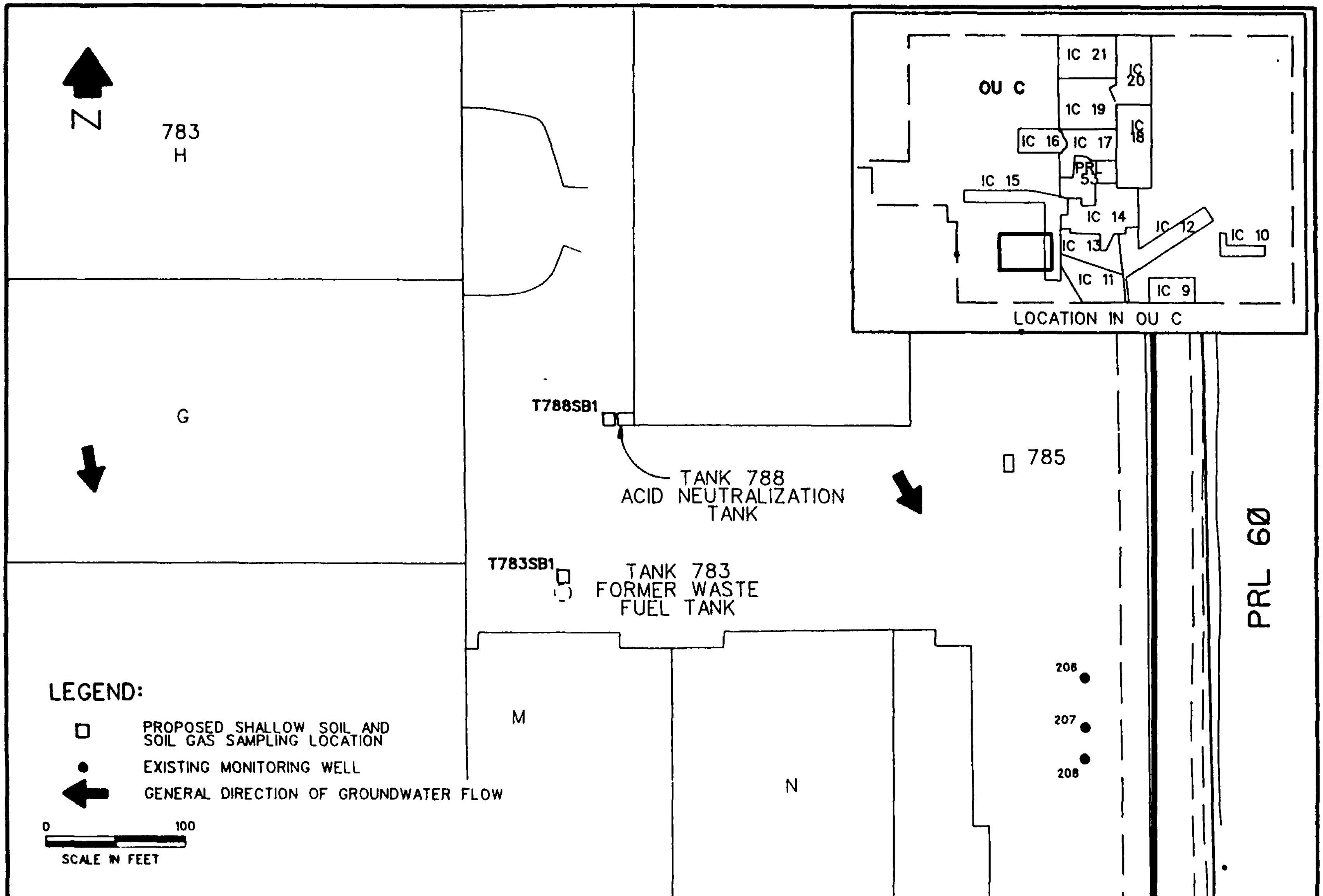


Figure 5.17-1 Proposed Sampling Locations at Tanks 788 and 783

OUC4 T783PSL VRL SAC 2/23/94

TABLE 5.17-1. DATA QUALITY OBJECTIVES FOR TANK 783

Problem Statement Waste fuel may have leaked into the subsurface from the UST or associated piping.
Decision to be Made • Determine if leaks from the UST/piping have contaminated the subsurface. • Determine the location priority.
Inputs to the Decision Level II/III for soil gas; Level III for TPH, BTEX, and organic lead.
Boundaries of the Study Soil and soil gas samples from approximately 10 to 40 feet BGS collected adjacent to the former tank location.
Decision Rule • If petroleum hydrocarbons are reported in soil adjacent to and/or beneath the tank, leaks from the tank have contaminated the environment. • If organic lead is reported in soil samples, then leaks from the tank have contaminated the subsurface. • If all data collected are validated, proceed to Data Evaluation DQOs (see Section 4.2.2).
Limits on Uncertainty Analytical data must meet project specifications for precision and accuracy.
Sample Design Boring T783SB01 will be placed adjacent to the former tank location as determined from Civil Engineering construction diagrams.

(Continued)

TABLE 5.17-1. (Continued)

DATA QUALITY OBJECTIVES FOR TANK 788

Problem Statement Contaminants may have leaked into the subsurface from the acid neutralization tank or associated piping.
Decision to be Made Determine if leaks from the acid neutralization tank/piping have contaminated the subsurface.
Inputs to the Decision Level II/III for soil gas; Level III for inorganics and pH.
Boundaries of the Study Soil samples from approximately 10 to 40 feet BGS collected adjacent to the tank.
Decision Rule • If inorganic species are reported above background concentration in soil samples, then leaks in the tank or its associated piping may have contaminated the subsurface and the decision process for inorganics should be applied. • If soil pH is reported outside the pH background range, then leaks in the tank or its associated piping may have contaminated the subsurface. • If all data collected are validated, proceed to Data Evaluation DQOs (see Section 4.2.2).
Limits on Uncertainty Analytical data must meet project specifications for precision and accuracy.
Sample Design Boring T788SB01 will be placed adjacent to the tank.

NOTE: All acronyms are defined on the acronym list at the beginning of the SAP.

TABLE 5.17-2. SAMPLING AND ANALYSIS MATRIX FOR TANKS 783 AND 788

Location:	Tank 783	Tank 788
Contaminant of Concern:	VOCs, TPH, BTEX, Organic lead	Acids, VOCs, Bases, Inorganic Species
Sampling Location:	Boring T7835B01	Boring T788SB01
Depth and Analytical Method:	(10′) HML 338, ModSW8015/3550, ModSW8015/5030 (15–25′) FGC (20′) HML 338, ModSW8015/3550, ModSW8015/5030 (35–45′) FGC	(10′) SW6[illegible], SW9045 (15–25′) FGC (20′) SW6010, SW9045 (35–45′) FGC

FGC = Screening analysis of soil gas for commonly detected VOCs with on-site chromatograph.

NOTE: Matrix represents the minimum number of samples to be collected in each horizon.
FGC analyses will be confirmed with 10% TO-14 analysis.
Specific sample depths will be determined in the field using the sampling criteria specified in Section 4.
All acronyms are defined on the acronym list at the beginning of the SAP.

TABLE 5.17-3. SAMPLING AND FIELD SPECIFICATIONS FOR TANKS 783 AND 788

Boring/Location Name	Reference Point	Distance	Maximum Depth Interval (ft BGS)
<u>Borings</u>			
T788SB01	Southwest corner of Bldg. 788	105'S, 50'W	45
T788SB01	Southwest corner of Bldg. 788	5'N, 18'W	45

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APPENDIX A

Groundwater Beneath Operable Unit (OU) C

GROUNDWATER BENEATH OPERABLE UNIT (OU) C

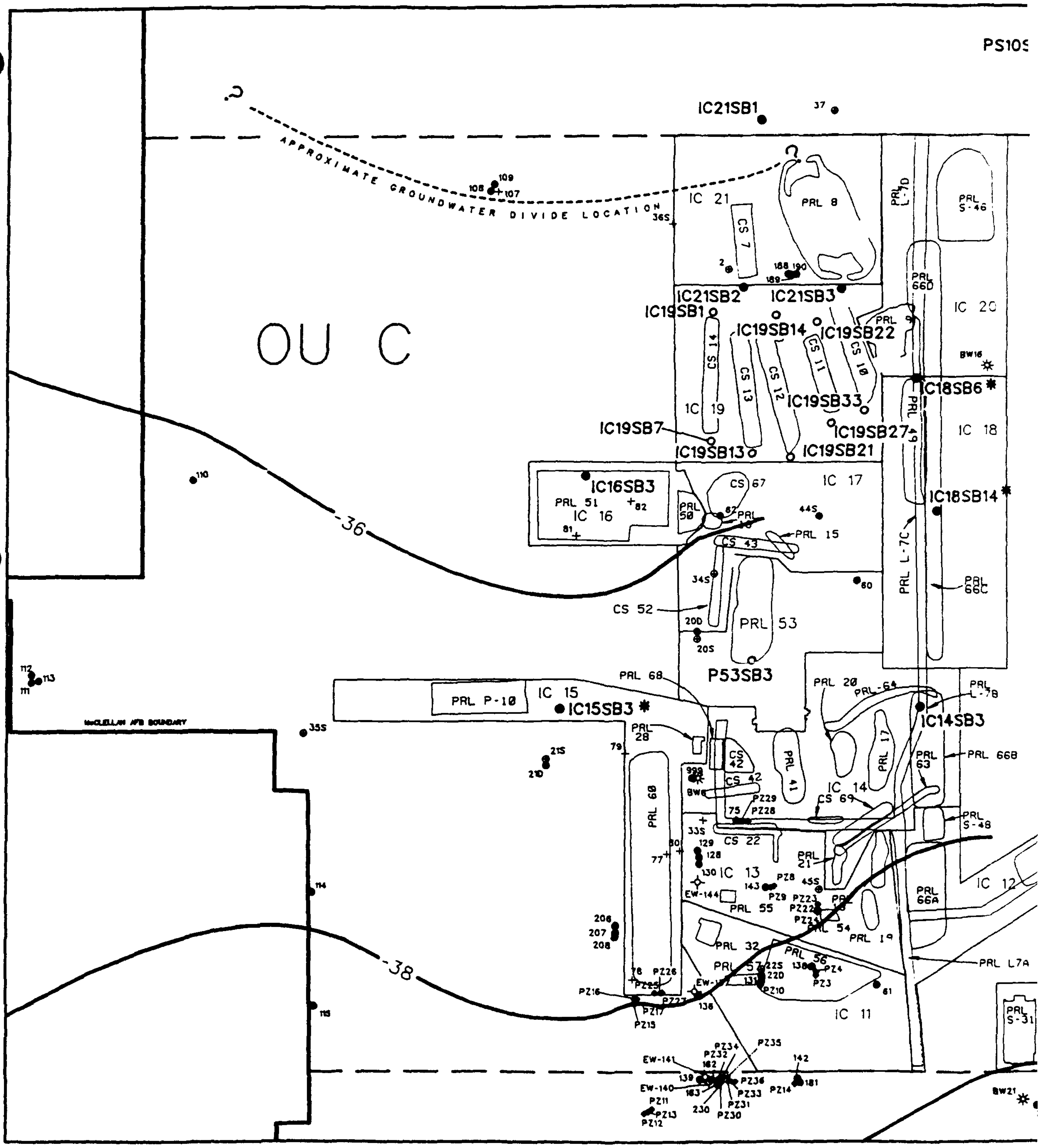
Groundwater beneath OU C is contaminated with volatile organic compounds (VOCs). Most of the compounds are solvents, primarily trichloroethene (TCE) and other halogenated VOCs (HVOCs), which have migrated to groundwater from near-surface sources and discharge points. Aromatic VOCs (AVOCs) have also been reported in groundwater in southern OU C, but are not as widespread as HVOC contamination. Extraction wells are currently operating in OU C to remove contaminated groundwater.

There are 31 active monitoring wells (MWs), 27 piezometers (PZs), and 4 extractions wells (EWs) in OU C which monitor contaminant migration, provide potentiometric data, or extract contaminated groundwater, respectively. The primary sources of HVOC groundwater contamination in OU C appear to be in the area designated OU C1, in central OU C. Trichloroethene concentrations in groundwater greater than 10,000 μg/L have been reported in this area. A second source appears to be located near or upgradient from MW-44S, perhaps at the burial pits of CS 11 or 12.

Most existing groundwater wells and piezometers are located in the southern portion of OU C. Gaps in groundwater quality and potentiometric data exist primarily in the northern and eastern portions of OU C; however, groundwater quality beneath some areas in the southern portion of OU C has not been defined. During the OU C Remedial Investigation (RI), at least 22 A zone groundwater samples will be collected to fill data gaps using a HydroPunch® (or equivalent) sampler and will be analyzed for VOCs (Figure A-1). (See discussion in Appendix B on collection of groundwater samples by HydroPunch®). Groundwater results from each of these locations will be evaluated by the OU C RI team and Groundwater OU team before the boring is abandoned to determine if a monitoring well should be installed. Twelve monitoring wells will be installed at the locations shown on Plate 2. Rationale for these locations are discussed below:

Potential Release Location (PRL) S-10:

The direction of groundwater flow near PRL S-10 has not been defined — there are no monitoring wells in this area — and the quality of the groundwater is unknown. Flow in this area may be affected by groundwater extraction systems operating in OU D located approximately 2,000 feet to the west.


PS10S
OU C
APPROXIMATE GROUNDWATER DIVIDE LOCATION
IC21SB1
IC21SB2
IC21SB3
IC19SB1
IC19SB14
IC19SB22
IC19SB33
IC19SB7
IC19SB13
IC19SB21
IC19SB27
IC18SB6
IC18SB14
IC16SB3
P53SB3
IC15SB3
IC14SB3
IC 21
IC 20
IC 19
IC 18
IC 17
IC 16
IC 15
IC 14
IC 13
IC 12
IC 11
PRL 8
PRL 51
PRL 53
PRL 55
PRL 60
PRL 68
PRL P-10
PRL L-7C
PRL L7A
PRL 66B
PRL 66C
PRL 66A
PRL S-46
PRL S-48
PRL S-31
CS 7
CS 14
CS 13
CS 12
CS 11
CS 10
CS 43
CS 52
CS 22
CS 42
CS 69
-36
-38
McCLELLAN AFB BOUNDARY
EW-141
EW-140
EW-144
BW16
BW21

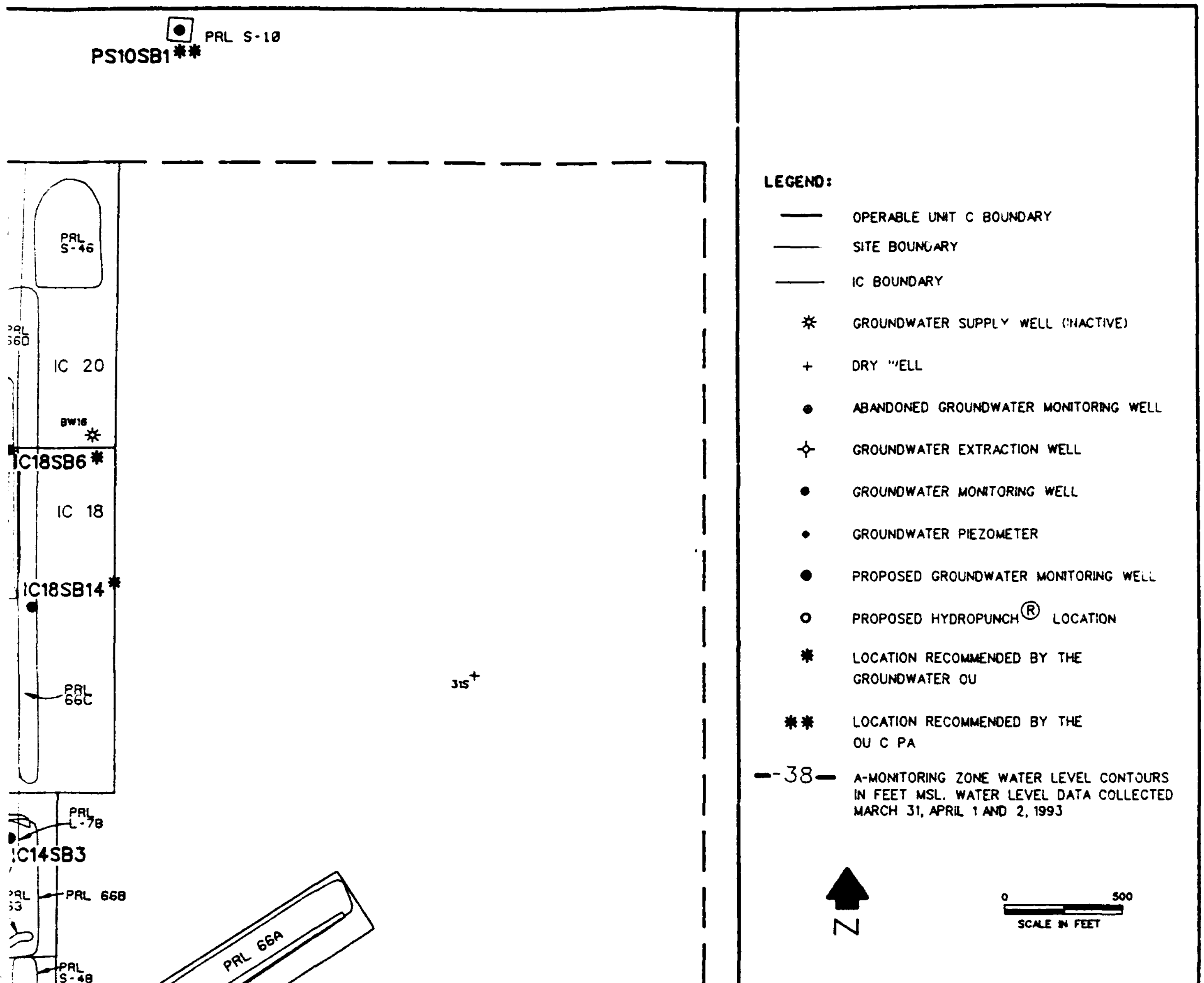


Figure A-1

Proposed Monitoring Wells, Proposed Groundwater Sampling Locations, and Existing A-Zone Wells in OU C

McCLELLAN AFB

February 25, 1994

A monitoring well (recommended in the OU C Preliminary Assessment [PA]) at PS10SB1 will provide samples to evaluate water quality and water levels to help determine the direction of groundwater flow.

Investigation Clusters (ICs) 19 and 21:

The landfills and pits at Confirmed Sites (CSs) 7, 10, 11, 12, 13, 14, and PRL 8 may be sources of groundwater contamination. The Regional Water Quality Control Board has indicated that landfill closure requirements may be Applicable or Relevant and Appropriate Requirements (ARARs) at these locations. Three A zone wells (IC21SB1 through IC21SB3) will be installed upgradient (to the north) and downgradient (to the south) of the landfill and pit in IC 21 to provide potentiometric data and monitor contaminant migration. HydroPunch® samples will be collected upgradient and downgradient of each pit in IC 19 to determine whether the pits have contributed to groundwater contamination. After the data are analyzed, two A monitoring zone wells may be installed downgradient of the pits to monitor contaminant migration.

A groundwater divide exists within or near IC 21. The divide is caused by the OU D extraction wells drawing groundwater to the north in opposition to the regional gradient (to the south). Water level measurements from the four wells will also help determine the location of the divide.

IC 18:

As noted in the Draft Groundwater OU RI report, groundwater flow directions and the extent of contamination are poorly defined in the eastern portion of OU C. Two A zone monitoring wells will be installed in IC 18 (IC18SB6 and IC18SB14) to help fill these data gaps. These wells will be installed next to the IWL and will also help determine if leaks from the line have contributed to groundwater contamination.

IC 16:

Groundwater flow directions and contaminant concentrations are poorly defined in northeastern OU C. An A zone monitoring well will be installed in

IC 16 (IC16SB3) to monitor flow directions in this area and determine groundwater quality.

IC 15:

The Groundwater OU RI report recommended a boring in this area to bound TCE groundwater contamination from OU C1 (just east of IC 15). An A zone monitoring well (IC15SB3) will be installed to help determine the extent of contamination northwest of OU C1.

IC 14:

A monitoring well will be installed (at IC14SB3) adjacent to the industrial wastewater line (IWL) where leaks were identified in 1988 by EG&G. An investigation in 1993 by Jacobs Engineering indicated that the IWL has been plugged at this location for an undetermined length of time following the 1988 investigation (Jacobs Engineering, forthcoming). Because wastewater could not pass this plug, water pressure in the line may have caused leakage through cracks up-stream (to the north) and/or at the location of the plug itself. The well will provide samples to evaluate water quality near the leaks and water levels to help determine the direction of groundwater flow.

IC 12:

The direction of groundwater flow and the quality of groundwater are not well defined in the eastern portion of IC 12. The test stands, IWL, and drainage ditch in IC 12 are potential discharge points/source areas for contamination. A monitoring well installed at IC12SB7 will monitor groundwater quality and help define the potentiometric surface in this area. This location was recommended in the Draft Groundwater OU RI report.

APPENDIX B

Standard Operating Procedures

STANDARD OPERATING PROCEDURE
HANDLING OF BURIED DRUMS
DURING INVESTIGATION OF LANDFILLS AND DISPOSAL PITS

1.0 OVERVIEW

The purpose of this standard operating procedure (SOP) is to establish procedures for managing field operations in the event that buried drums are encountered during the remedial investigation of landfills or disposal pits. There is potential that drums with unknown contents will be excavated during the course of landfill or disposal pit exploration. Hazards that could result from the handling of buried drums include fire, explosion, toxic vapor generation, and physical injury resulting from moving liquid or solid-filled containers. There is also potential of causing soil contamination if the drums contain liquid contaminants and are unsealed or broken during excavation.

Magnetic and electromagnetic geophysical survey methods (See Standard Operating Procedure for Conducting Magnetic and Electromagnetic Surveys) will be used to determine the presence of buried drums prior to excavation; however, the condition of buried drums may not be identifiable with the geophysical methods. The procedures and equipment described here are intended to reduce the health and safety hazards and the soil contamination hazards that could arise when drums are encountered.

2.0 EQUIPMENT

The equipment needed for investigation of landfills and disposal pits is:

> <u>Combustible Gas Indicator (CGI)</u>. A calibrated CGI is required at any landfill or disposal pit location to measure potentially explosive gases from drum contents. The CGI will measure the percentage of the lower explosive limit (LEL) attained by the concentration of total hydrocarbon (THC) emissions from the trench.
>
> <u>Photoionization Detector (PID)</u>. A PID is required to monitor organic compound concentrations in soil gas from trenches. Calibration gas will be available to calibrate the PID before each day of use.

Gamma Ray Detector or Geiger-Mueller Counter. Drums may have been used historically to contain radioactive materials. A gamma ray detector or Geiger-Mueller counter will be available during pit excavation to screen soils and drums for hazardous levels of radioactivity before attempts are made to move or sample them.

Draeger® Tubes. Draeger tubes that indicate the concentrations of toxic organic compounds potentially present in soil gas are required. The Health and Safety Plan prepared for the remedial investigation specifies the types of tubes needed and their use.

Personal Protective Equipment. Levels D and C protective equipment will be essential during the excavation. If leaking drums of hazardous wastes are discovered or if sealed drums are to be transported and sampled, Level A or B protection, with supplied air, will be available to workers. See Health and Safety Plan for details.

Health and Safety Plan. Copies of the remedial investigation Health and Safety Plan are required at all landfill/disposal pit investigation locations. Each field worker at the location will understand the procedures needed to maintain health and safety.

Cellular Phone. A cellular phone will be available at the investigation location. The phone will be used to call the fire department and emergency services in the event of an explosion or fire.

Drum Grappler. A drum grappler attachment for the excavator will be available for removal of uncovered drums from the excavation.

Chemical-Resistant Plastic Sheeting. Chemical-resistant plastic sheeting will be available to cover the ground surface and a 8-inch high enclosing berm beneath the area where each drum or adjacent contaminated soils are brought to the surface for repackaging and transportation.

Specialized Drum Handling Equipment. Equipment specifically designed for lifting and moving drums, opening sealed drums, and overpacking drums prior to transport for storage or disposal is described in Chapter 11 of Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities (1985), which is included as an attachment to this SOP.

Notebook. A notebook for documenting: the location and dimensions of the trench; equipment used for trench, boring, and monitoring; CGI, PID, or radioactivity measurements and their location and depth in the trench; decisions made on the basis of any readings exceeding safe levels; actions taken; and any changes in the condition of personnel as a result of high monitor readings or other safety concerns.

3.0 PROCEDURE

The attachment to this procedure was prepared by the National Institute for Occupational Health, the Occupational Safety and Health Administration, the U.S. Coast Guard, and the Environmental Protection Agency for handling buried and surface-stored drums and other containers. The precautions and procedures in the attachment are applicable to the drum handling that may be required during pit excavation. Therefore, the procedures presented here cite appropriate sections of the attachment.

Preparations

1. Before mobilizing excavation equipment to the investigation location, prepare staging areas, described in the attachment, for temporary holding, opening and sampling, overpacking, and transport; all health and safety supplies, heavy equipment, and sampling supplies needed for those operations should be readily available, but not on standby, to allow those operations to proceed if drums are encountered.

2. Before starting any excavation at a landfill or disposal pit, the project Health and Safety Officer will review with the field crew the procedures necessary to maintain health and safety in the event that hazardous waste drums are encountered; review the Inspection procedures section of the

attachment to assure that the appropriate precautions are taken if symbols on the drum or the type of drum indicate the type of waste it contains.

3. Establish a 100-foot Exclusion Zone on both sides of the trench location.

4. Check the battery and calibration of the CGI, PID, and gamma-ray detector; check the operation of the cellular phone; and place fire department and emergency services phone numbers near the phone.

5. Before disturbing the surface soils, measure background concentrations of organic compounds with the PID and concentrations of total hydrocarbons with the CGI; document the readings along with the location, date, time, weather conditions, and names of all personnel working at the location.

Trenching:

6. Begin the trenching in accordance with the procedures described in the trenching SOP; if geophysical surveys over the trench area indicated the presence of buried objects, trenching should be conducted very carefully to prevent rupturing of sealed drums or overturning of unsealed or broken drums.

7. As each new section of trench is excavated, monitor soil gas emissions and radioactivity reaching the ground surface-mouth of the trench (GS) and the breathing zone (BZ); see the Health and Safety Plan for procedures to take if unsafe levels in LEL, PID, and radioactivity readings are detected.

8. If evidence of a drum is encountered in the excavation, alert the excavator operator of its presence and direct the operator to cautiously proceed with uncovering the drum so that it can be identified and removed; it may be necessary to open the trench to allow removal of the drum after it is uncovered; begin continuous monitoring of LEL, organic vapors, and radioactivity while the drum is being uncovered.

9. Prepare the GS area near the drum for removal; spread chemical-resistant plastic sheeting; bring the drum gappling equipment to the location and new or overpack drums that will receive the buried drum, its contents, and contaminated soils.

10. Attempt to identify the potential contents and condition of the drum following Handling procedures in the attachment.

11. If the drum is leaking or deteriorated, follow the specific procedures in the attachment for Leaking, Open,and Deteriorated drums. Continuously monitor LEL, organic vapor, and radioactivity, and take actions specified in the Health and Safety Plan if unsafe levels are detected.

12. When the drum is sufficiently excavated to be removed, the drum grappling equipment should be used to lift the drum onto the chemical-resistant sheeting; if it is leaking or has indications of deterioration or rupture, it should be placed into an overpack drum and sealed before transport to the holding/sampling area.

13. If there is evidence that liquids or solids have leaked from the drum, use the excavator to remove visibly-contaminated soils to a depth of 5 feet below the drum; place the soils in new drums that have been moved onto the chemical-resistant sheeting.

14. Take LEL, organic vapor, and radioactivity readings of the removed soils; if readings are not greater than safe levels, collect representative samples of the drummed soils prior to sealing the container; if the drum contents have not been identified from their obvious physical characteristics, collect samples for measurement of:

- Reactivity,
- Corrosivity,
- Ignitability,
- Pesticides and polychlorinated biphenyls,
- Halogenated and aromatic volatile organic compounds,
- Semivolatile organic compounds,

- Total extractable petroleum hydrocarbons,
- Total inorganic species, and
- If there are radioactivity readings greater than background, total alpha and beta and total gamma.

15. After drum removal, contaminated soil removal, and soil sampling are completed, return to step #6.

16. For drums that have been removed from the trench and taken to holding or sampling areas, follow procedures in the attachment for Opening, Sampling, Bulking , Staging, and Shipment.

11. Handling Drums and Other Containers

Contents

Introduction

Accidents may occur during handling of drums and other hazardous waste containers. Hazards include detonations, fires, explosions, vapor generation, and physical injury resulting from moving heavy containers by hand and working around stacked drums, heavy equipment, and deteriorated drums. While these hazards are always present, proper work practices—such as minimizing handling and using equipment and procedures that isolate workers from hazardous substances—can minimize the risks to site personnel.

This chapter defines practices and procedures for safe handling of drums and other hazardous waste containers. It is intended to aid the Project Team Leader in setting up a waste container handling program. In addition to reading this chapter, the Project Team Leader should also be aware of all pertinent regulations. OSHA regulations (29 CFR Parts 1910 and 1926) include general requirements and standards for storing, containing, and handling chemicals and containers, and for maintaining equipment used for handling materials. EPA regulations (40 CFR Part 265) stipulate requirements for types of containers, maintenance of containers and containment structures, and design and maintenance of storage areas. DOT regulations (49 CFR Parts 171 through 178) also stipulate requirements for containers and procedures for shipment of hazardous wastes.

Containers are handled during characterization and removal of their contents and during other operations. A flow chart showing one set of possible procedures for drum handling is given in Figure 11-1. Guidance for safely performing the procedures shown in Figure 11-1 is provided in the following sections of this chapter. The final section, *Special Case Problems*, describes the handling of tanks, vaults, vacuum trucks, elevated tanks, and compressed gas cylinders.

Inspection

The appropriate procedures for handling drums depend on the drum contents. Thus, prior to any handling, drums should be visually inspected to gain as much information as possible about their contents. The inspection crew should look for:

- Symbols, words, or other marks on the drum indicating that its contents are hazardous, e.g., radioactive, explosive, corrosive, toxic, flammable.
- Symbols, words, or other marks on a drum indicating that it contains discarded laboratory chemicals, reagents, or other potentially dangerous materials in small-volume individual containers (see Table 11-1).
- Signs of deterioration such as corrosion, rust, and leaks.
- Signs that the drum is under pressure such as swelling and bulging.
- Drum type (see Table 11-1).
- Configuration of the drumhead (see Table 11-2).

Conditions in the immediate vicinity of the drums may provide information about drum contents and their associated hazards. Monitoring should be conducted around the drums using instruments such as a gamma radiation survey instrument, organic vapor monitors, and a combustible gas meter.

The results of this survey can be used to classify the drums into preliminary hazard categories, for example:

- Radioactive.
- Leaking/deteriorated.
- Bulging.
- Explosive/shock-sensitive.
- Contains small-volume individual containers of laboratory wastes or other dangerous materials.

As a precautionary measure, personnel should assume that unlabelled drums contain hazardous materials until their contents are characterized. Also, they should bear in mind that drums are frequently mislabelled—particularly drums that are reused. Thus, a drum's label may not accurately describe its contents.

If buried drums are suspected, ground-penetrating systems, such as electromagnetic wave, electrical resistivity, ground-penetrating radar, magnetometry, and metal detection, can be used to estimate the location and depth of the drums.

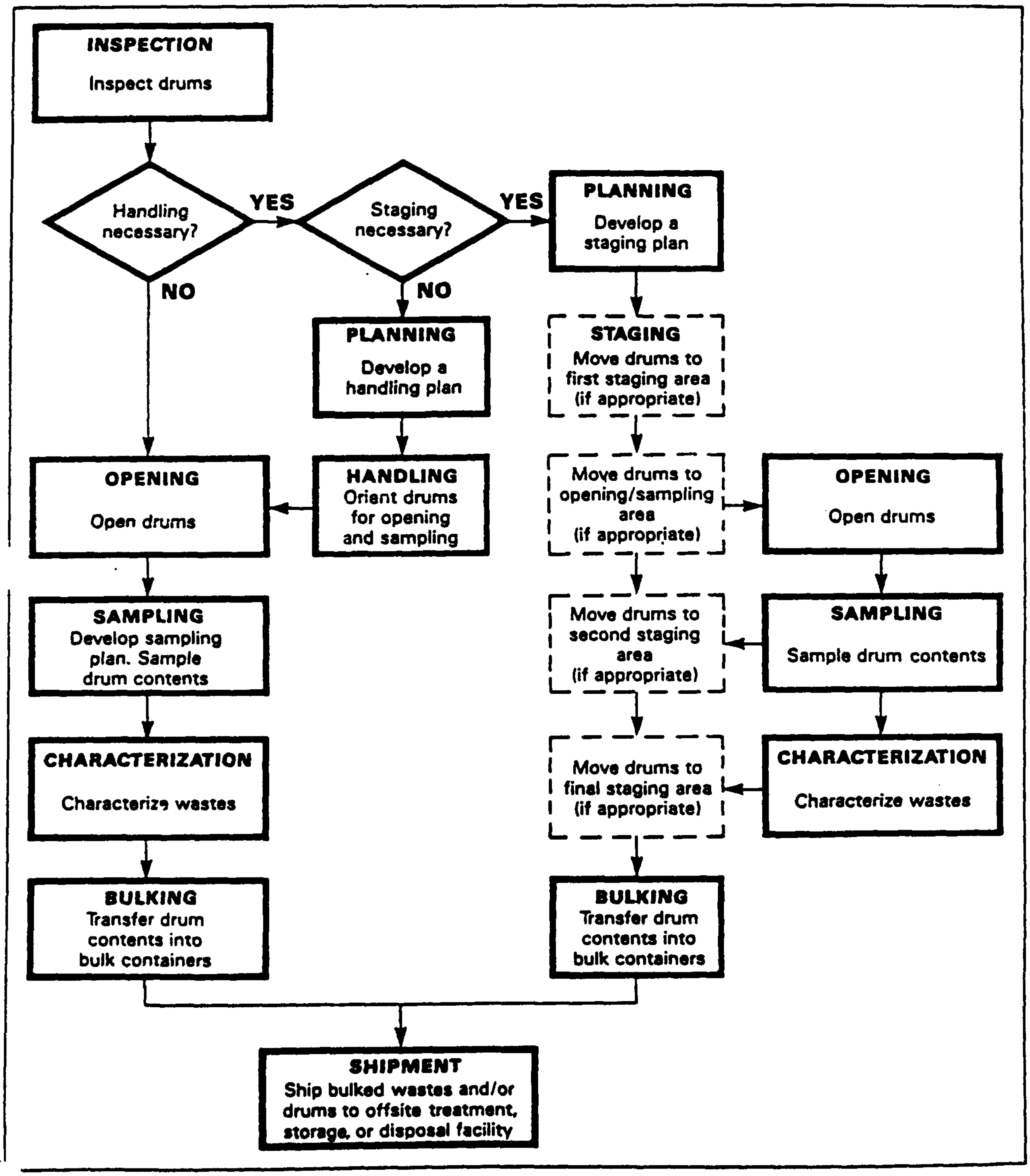


Figure 11-1. Flow Chart for Drum Handling. (Dashed boxes indicate optional steps. Number of staging areas necessary is site specific.)

Table 11-1. Special Drum Types and Their Associated Hazards

Polyethylene or PVC-Lined Drums	Often contain strong acids or bases. If the lining is punctured, the substance usually quickly corrodes the steel, resulting in a significant leak or spill.
Exotic Metal Drums (e.g., aluminum, nickel, stainless, steel, or other unusual metal)	Very expensive drums that usually contain an extremely dangerous material.
Single-Walled Drums Used as a Pressure Vessel	These drums have fittings for both product filling and placement of an inert gas, such as nitrogen. May contain reactive, flammable, or explosive substances.
Laboratory Packs	Used for disposal of expired chemicals and process samples from university laboratories, hospitals, and similar institutions. Individual containers within the lab pack are often not packed in absorbent material. They may contain incompatible materials, radioisotopes, shock-sensitive, highly volatile, highly corrosive, or very toxic exotic chemicals. Laboratory packs can be an ignition source for fires at hazardous waste sites.

Table 11-2. Information Provided by Drumhead Configuration

CONFIGURATION	INFORMATION
Whole lid removable.	Designed to contain solid material.
Has a bung.	Designed to contain a liquid.
Contains a liner.	May contain a highly corrosive or otherwise hazardous material.

Planning

Since drum handling is fraught with danger, every step of the operation should be carefully planned, based on all the information available at the time. The results of the preliminary inspection can be used to determine (1) if any hazards are present and the appropriate response, and (2) which drums need to be moved in order to be opened and sampled. A preliminary plan should be developed which specifies the extent of handling necessary, the personnel selected for the job, and the most appropriate procedures based on the hazards associated with the probable drum contents as determined by visual inspection. This plan should be revised as new information is obtained during drum handling.

Handling

The purpose of handling is to (1) respond to any obvious problems that might impair worker safety, such as radioactivity, leakage, or the presence of explosive substances, (2) unstack and orient drums for sampling, and (3) if necessary, to organize drums into different areas on site to facilitate characterization and remedial action (see *Staging* in this chapter). Handling may or may not be necessary, depending on how the drums are positioned at a site.

Since accidents occur frequently during handling, particularly initial handling, drums should only be handled if necessary. Prior to handling, all personnel should be warned about the hazards of handling, and instructed to minimize handling as much as possible and to avoid unnecessary handling. In all phases of handling, personnel should be alert for new information about potential hazards. These hazards should be responded to before continuing with more routine handling operations. Overpack drums (larger drums in which leaking or damaged drums are placed for storage or shipment [see 49 CFR Part 173.3(c)]) and an adequate volume of absorbent should be kept near areas where minor spills may occur. Where major spills may occur, a containment berm adequate to contain the entire volume of liquid in the drums should be constructed before any handling takes place. If the drum contents spill, personnel trained in spill response should be used to isolate and contain the spill.

Several types of equipment can be used to move drums: (1) A drum grappler attached to a hydraulic excavator; (2) a small front-end loader, which can be either loaded manually or equipped with a bucket sling; (3) a rough terrain forklift; (4) a roller conveyor equipped with solid rollers; and (5) drum carts designed specifically for drum handling. Drums are also sometimes moved manually. The drum grappler is the preferred piece of equipment for drum handling. It keeps the operator removed from the drums so that there is less likelihood of injury if the drums detonate or rupture. If a drum is leaking, the operator can stop the leak by rotating the drum and immediately placing it into an overpack. In case of an explosion, grappler claws help protect the operator by partially deflecting the force of the explosion.

Backhoe with drum grappler.

The following procedures can be used to maximize worker safety during drum handling and movement:

- Train personnel in proper lifting and moving techniques to prevent back injuries.
- Make sure the vehicle selected has sufficient rated load capacity to handle the anticipated loads, an

make sure the vehicle can operate smoothly on the available road surface.

- Air condition the cabs of vehicles to increase operator efficiency; protect the operator with heavy splash shields.
- Supply operators with appropriate respiratory protective equipment when needed. Normally either a combination SCBA/SAR with the air tank fastened to the vehicle, or an airline respirator and an escape SCBA are used because of the high potential hazards of drum handling. This improves operator efficiency and provides protection in case the operator must abandon the equipment.
- Have overpacks ready before any attempt is made to move drums.
- Before moving anything, determine the most appropriate sequence in which the various drums and other containers should be moved. For example, small containers may have to be removed first to permit heavy equipment to enter and move the drums.
- Exercise extreme caution in handling drums that are not intact and tightly sealed.
- Ensure that operators have a clear view of the roadway when carrying drums. Where necessary, have ground workers available to guide the operator's motion.

Drums Containing Radioactive Waste

- If the drum exhibits radiation levels above background (see Table 8-2), immediately contact a health physicist. Do *not* handle any drums that are determined to be radioactive until persons with expertise in this area have been consulted.

Drums that May Contain Explosive or Shock-Sensitive Waste

- If a drum is suspected to contain explosive or shock-sensitive waste as determined by visual inspection, seek specialized assistance before any handling.
- If handling is necessary, handle these drums with *extreme caution.*
- Prior to handling these drums, make sure all non-essential personnel have moved a safe distance away.
- Use a grappler unit constructed for explosive containment for initial handling of such drums.
- Palletize the drums prior to transport. Secure drums to pallets.
- Use an audible siren signal system, similar to that employed in conventional blasting operations, to signal the commencement and completion of explosive waste handling activities.
- Maintain continuous communication with the Site Safety Officer and/or the command post until drum handling operations are complete.

Bulging Drums

- Pressurized drums are extremely hazardous. Wherever possible, do not move drums that may be under internal pressure, as evidenced by bulging or swelling.
- If a pressurized drum has to be moved, whenever possible handle the drum with a grappler unit constructed for explosive containment. Either move the bulged drum only as far as necessary to allow seating on firm ground, or carefully overpack the drum. Exercise extreme caution when working with or adjacent to potentially pressurized drums.

Drums Containing Packaged Laboratory Wastes (Lab Packs)

Laboratory packs (i.e., drums containing individual containers of laboratory materials normally surrounded by cushioning absorbent material) can be an ignition source for fires at hazardous waste sites. They sometimes contain shock-sensitive materials. Such containers should be considered to hold explosive or shock-sensitive wastes until otherwise characterized. If handling is required, the following precautions are among those that should be taken:

- Prior to handling or transporting lab packs, make sure all non-essential personnel have moved a safe distance away.
- Whenever possible, use a grappler unit constructed for explosive containment for initial handling of such drums.
- Maintain continuous communication with the Site Safety Officer and/or the command post until handling operations are complete.
- Once a lab pack has been opened, have a chemist inspect, classify, and segregate the bottles within it, without opening them, according to the hazards of the wastes. An example of a system for classifying lab pack wastes is provided in Table 11-3. The objective of a classification system is to ensure safe segregation of the lab packs' contents. Pack these bottles with sufficient cushioning and absorption materials to prevent excessive movement of the bottles and to absorb all free liquids, and ship them to an approved disposal facility.
- If crystalline material is noted at the neck of any bottle, handle it as a shock-sensitive waste, due to the potential presence of picric acid or other similar material, and get expert advice before attempting to handle it.
- Palletize the repacked drums prior to transport. Secure the drums to pallets.

Leaking, Open, and Deteriorated Drums

- If a drum containing a liquid cannot be moved without rupture, immediately transfer its contents to a sound drum using a pump designed for transfering that liquid.
- Using a drum grappler, place immediately in overpack containers:

  Leaking drums that contain sludges or semi-solids.

  Open drums that contain liquid or solid waste.

  Deteriorated drums that can be moved without rupture.

Table 11-3. Example of Lab Pack Content Classification System for Disposal

CLASSIFICATION	EXAMPLES
Inorganic acids	Hydrochloric Sulfuric
Inorganic bases	Sodium hydroxide Potassium hydroxide
Strong oxidizing agents	Ammonium nitrate Barium nitrate Sodium chlorate Sodium peroxide
Strong reducing agents	Sodium thiosulfate Oxalic acid Sodium sulphite
Anhydrous organics and organometallics	Tetraethyl lead Phenylmercuric chloride
Anhydrous inorganics and metal hydrides	Potassium hydride Sodium hydride Sodium metal Potassium
Toxic organics	PCBs Insecticides
Flammable organics	Hexane Toluene Acetone
Inorganics	Sodium carbonate Potassium chloride
Inorganic cyanides	Potassium cyanide Sodium cyanide Copper cyanide
Organic cyanides	Cyanoacetamide
Toxic metals	Arsenic Cadmium Lead Mercury

Buried Drums

- Prior to initiating subsurface excavation, use ground-penetrating systems to estimate the location and depth of the drums (see *Inspection* in this chapter).
- Remove soil with great caution to minimize the potential for drum rupture.
- Have a dry chemical fire extinguisher on hand to control small fires.

Opening

Drums are usually opened and sampled in place during site investigations. However, remedial and emergency operations may require a separate drum opening area (see *Staging* in this chapter). Procedures for opening drums are the same, regardless of where the drums are opened. To enhance the efficiency and safety of drum-opening personnel, the following procedures should be instituted.

- If a supplied-air respiratory protection system is used, place a bank of air cylinders outside the work area and supply air to the operators via airlines and escape SCBAs. This enables workers to operate in relative comfort for extended periods of time.
- Protect personnel by keeping them at a safe distance from the drums being opened. If personnel must be located near the drums, place explosion-resistant plastic shields between them and the drums to protect them in case of detonation. Locate controls for drum opening equipment, monitoring equipment, and fire suppression equipment behind the explosion-resistant plastic shield.
- If possible, monitor continuously during opening. Place sensors of monitoring equipment, such as colorimetric tubes, dosimeters, radiation survey instruments, explosion meters, organic vapor analyzers, and oxygen meters, as close as possible to the source of contaminants, i.e., at the drum opening.
- Use the following remote-controlled devices for opening drums:

  Pneumatically operated impact wrench to remove drum bungs.

  Hydraulically or pneumatically operated drum piercers (see Figure 11-2).

  Backhoes equipped with bronze spikes for penetrating drum tops in large-scale operations (see Figure 11-3).
- Do *not* use picks, chisels and firearms to open drums.
- Hang or balance the drum opening equipment to minimize worker exertion.
- If the drum shows signs of swelling or bulging, perform all steps slowly. Relieve excess pressure prior to opening and, if possible, from a remote location using such devices as a pneumatic impact wrench or hydraulic penetration device. If pressure must be relieved manually, place a barrier such as explosion-resistant plastic sheeting between the worker and bung to deflect any gas, liquid, or solids which may be expelled as the bung is loosened.

Two drums with rusted bungs were opened by backhoes with bronze spikes and now await sampling. Drum in foreground has been labelled "150" for sample documentation purposes.

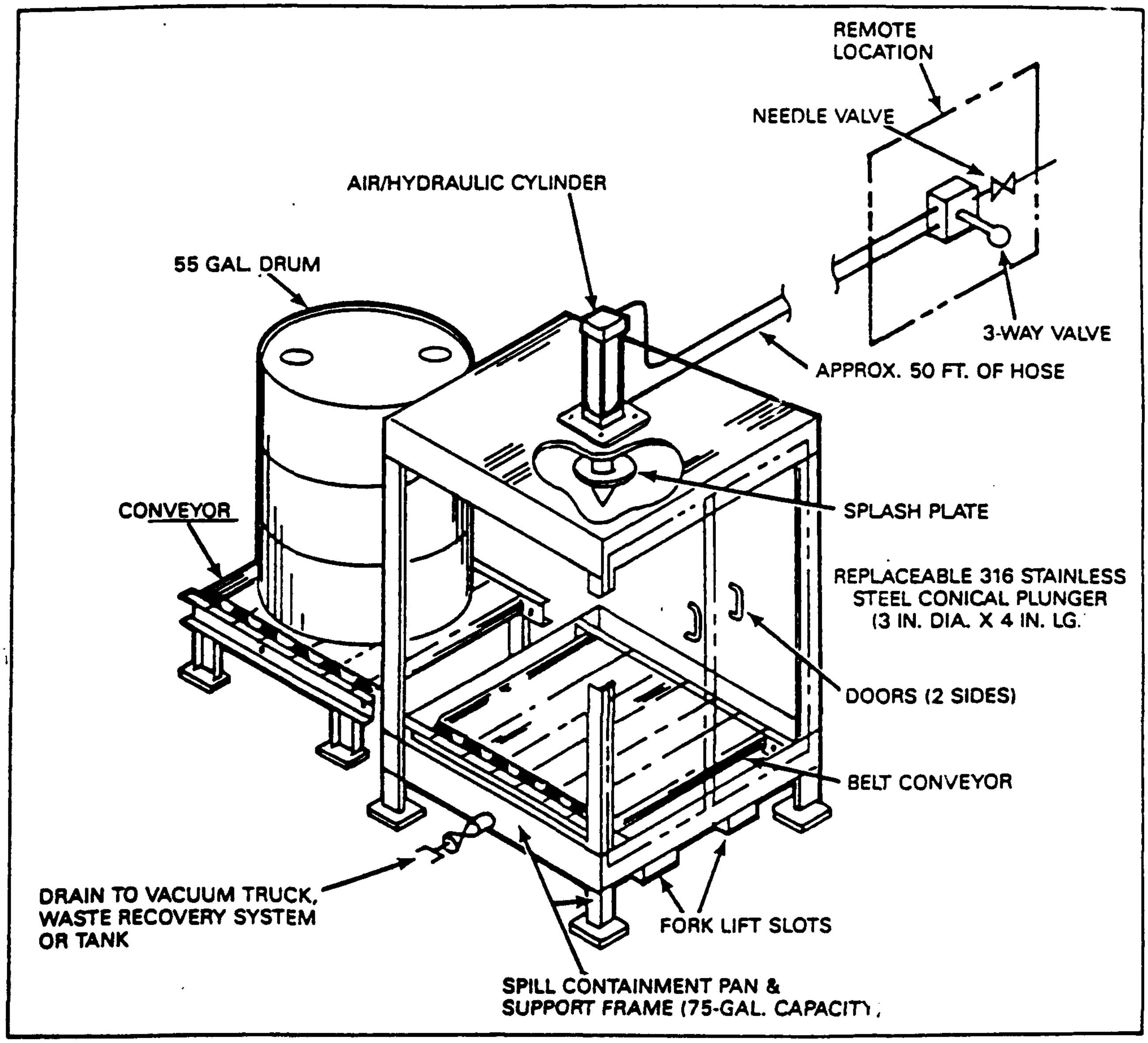


Figure 11-2. Air/Hydraulic-Operated Single-Drum Puncture Device.
Source: Reference [1].

- Open exotic metal drums and polyethylene or polyvinyl chloride-lined (PVC-lined) drums through the bung by removal or drilling. Exercise extreme caution when manipulating these containers.
- Do *not* open or sample individual containers within laboratory packs.
- Reseal open bungs and drill openings as soon as possible with new bungs or plugs to avoid explosions and/or vapor generation. If an open drum cannot be resealed, place the drum into an overpack. Plug any openings in pressurized drums with pressure-venting caps set to a 5-psi (pounds per square inch) release to allow venting of vapor pressure.
- Decontaminate equipment after each use to avoid mixing incompatible wastes.

Sampling

Drum sampling can be one of the most hazardous activities to worker safety and health because it often involves direct contact with unidentified wastes. Prior to collecting any sample, develop a sampling plan:

- Research background information about the waste.
- Determine which drums should be sampled.
- Select the appropriate sampling device(s) and container(s).

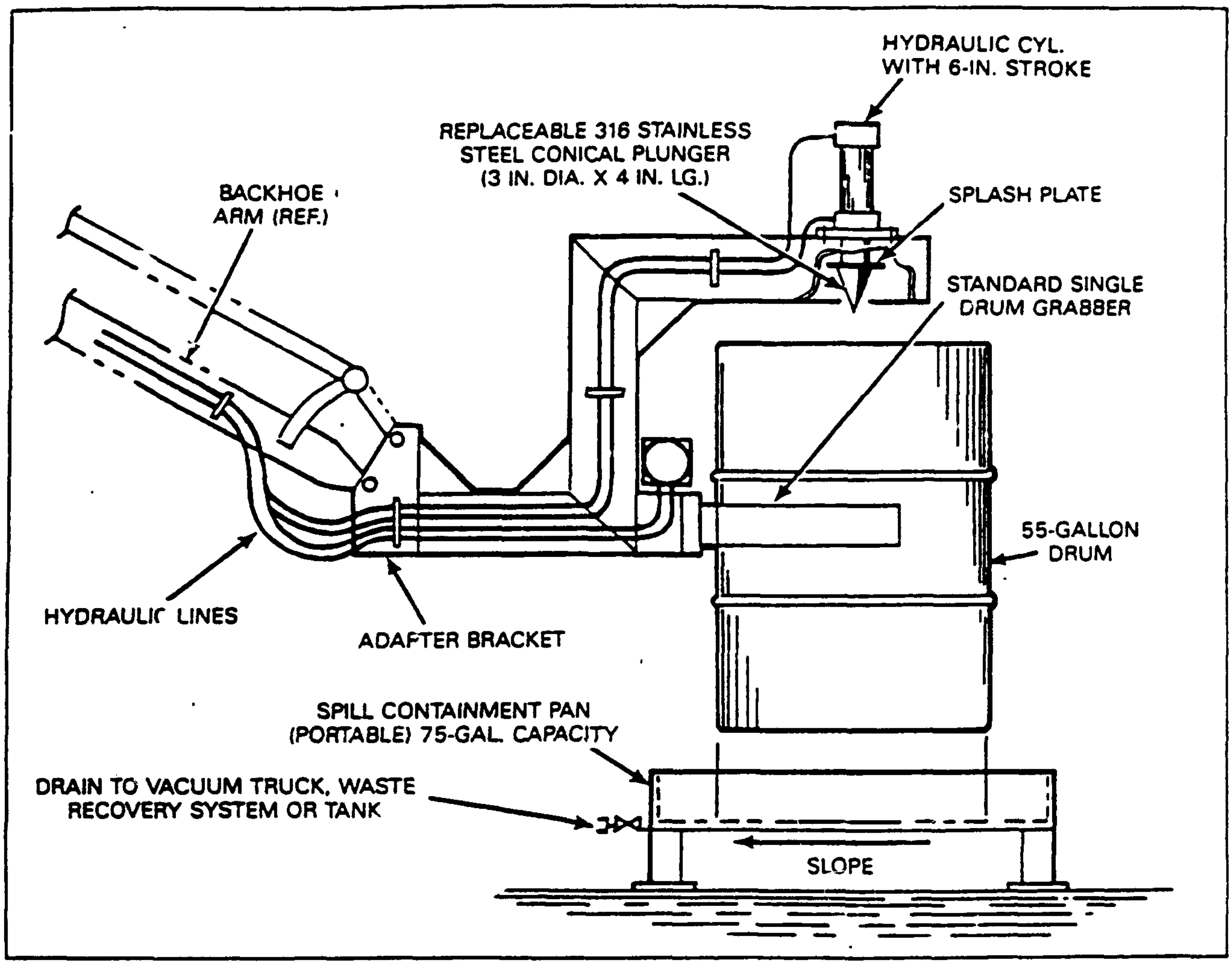


Figure 11-3. Backhoe-Mounted Drum Puncture Device.
Source: Reference [1].

- Develop a sampling plan which includes the number, volume, and locations of samples to be taken.
- Develop Standard Operating Procedures for opening drums, sampling, and sample packaging and transportation. Some guidance in designing proper sampling procedures can be found in References [2] and [3].
- Have a trained health and safety professional determine, based on available information about the wastes and site conditions, the appropriate personal protection to be used during sampling, decontamination, and packaging of the sample.

When manually sampling from a drum, use the following techniques:

- Keep sampling personnel at a safe distance while drums are being opened. Sample only after opening operations are complete.
- Do *not* lean over other drums to reach the drum being sampled, unless absolutely necessary.
- Cover drum tops with plastic sheeting or other suitable noncontaminated materials to avoid excessive contact with the drum tops.
- *Never* stand on drums. This is extremely dangerous. Use mobile steps or another platform to achieve the height necessary to safely sample from the drums.
- Obtain samples with either glass rods or vacuum pumps. Do *not* use contaminated items such as discarded rags to sample. The contaminants may contaminate the sample and may not be compatible with the waste in the drum. Glass rods should be removed prior to pumping to minimize damage to pumps.

Characterization

The goal of characterization is to obtain the data necessary to determine how to safely and efficiently package and transport the wastes for treatment and/or disposal. If wastes are bulked, they must be sufficiently character-

SITE: ______ DRUM NO. ______ SAMPLE NO. ______

DRUM SIZE:		DRUM OPENING:		DRUM TYPE:		SCREENING RESULTS (AREA):	
0 unknown	___	0 unknown	___	0 unknown	___	0 unknown	
1 55 gal.	___	1 ring top	___	1 metal	___	1 radioactive	___
2 30 gal.	___	2 closed top	___	2 plastic	___	2 acid/oxidizer	___
3 other	___	3 open top	___	3 fiber	___	3 caustic/reducer/cyanide	___
specify	___	4 other	___	4 glass	___	4 flammable organic	___
		specify	___	5 other	___	5 nonflammable organic	___
				specify	___	6 peroxide	___
						7 air or water reactive	___
						8 inert	___

DRUM COLOR:	PRI	SEC
0 unknown	___	___
1 cream	___	___
2 clear	___	___
3 black	___	___
4 white	___	___
5 red	___	___
6 green	___	___
7 blue	___	___
8 brown	___	___
9 pink	___	___
10 orange	___	___
11 yellow	___	___
12 gray	___	___
13 purple	___	___
14 amber	___	___
15 green-blue	___	___

DRUM CONTENTS COLOR:		
0 unknown	___	___
1 cream	___	___
2 clear	___	___
3 black	___	___
4 white	___	___
5 red	___	___
6 green	___	___
7 blue	___	___
8 brown	___	___
9 pink	___	___
10 orange	___	___
11 yellow	___	___
12 gray	___	___
13 purple	___	___
14 amber	___	___
15 green-blue	___	___

DRUM CONDITION:	
0 unknown	___
1 good	___
2 fair	___
3 poor	___

DRUM MARKING KEYWORD 1 ______

DRUM MARKING KEYWORD 2 ______

DRUM MARKING KEYWORD 3 ______

DRUM CONTENTS STATE:	PRI	SEC
0 unknown	___	___
1 solid	___	___
2 liquid	___	___
3 sludge	___	___
4 gas	___	___
5 trash	___	___
6 dirt	___	___
7 gel	___	___

DRUM CONTENT AMOUNT:	
0 unknown	___
1 full	___
2 part	___
3 empty	___

CHEMICAL ANALYSIS:	YES	NO
radiation	___	___
ignitable	___	___
water reactive	___	___
cyanide	___	___
oxidizer	___	___
organic vapor	___ ppm	
pH	___	

SCREENING DATA:

	YES	NO	
RADIOACTIVE	___	___	≥ 1 mR over background
ACIDIC	___	___	pH ≤ 3
CAUSTIC	___	___	pH ≥ 12
AIR REACTIVE	___	___	Reaction of ≥ 10°F temp. change
WATER REACTIVE	___	___	Reaction of ≥ 10°F temp. change
WATER SOLUBLE	___	___	Dissolves in water
WATER BATH OVA	___	___	Reading = ___ ≥ 10 ppm = Yes
COMBUSTIBLE	___	___	Catches fire when torched in water bath
HALIDE	___	___	Green flame when heated with copper
INORGANIC	___	___	WATER BATH OVA and COMBUSTIBLE = No
ORGANIC	___	___	INORGANIC = No
ALCOHOL/ALDEHYDE	___	___	WATER BATH OVA, WATER SOLUBLE and COMBUSTIBLE = Yes
CYANIDE	___	___	Draeger tube over water bath ≥ 2 ppm
FLAMMABLE	___	___	COMBUSTIBLE = Yes, and SETA flashpoint ≤ 140°F
OXIDIZER	___	___	Starch iodine paper shows positive reaction
INERT OR OTHER	___	___	Everything "No" except INORGANIC or ORGANIC

Figure 11-4. Sample Drum Characterization Sheet.
Source: EPA Region VII Emergency Planning and Response Branch. (This figure is provided only as an example. Values were selected by EPA Region VII and should be modified as appropriate.)

ized to determine which of them can be safely combined (see *Bulking* later in this chapter). As a first step in obtaining these data, standard tests should be used to classify the wastes into general categories, including auto-reactives, water reactives, inorganic acids, organic acids, heavy metals, pesticides, cyanides, inorganic oxidizers, and organic oxidizers. In some cases, further analysis should be conducted to more precisely identify the waste materials. See Figure 11-4 for an example of a characterization sheet for drums.

When possible, materials should be characterized using an onsite laboratory. This provides data as rapidly as possible, and minimizes the time lag before appropriate action can be taken to handle any hazardous materials. Also, it precludes any potential problems associated with transporting samples to an offsite laboratory (e.g., sample packaging, waste incompatibility, fume generation).

If samples must be analyzed off site, samples should be packaged on site in accordance with DOT regulations (49 CFR) and shipped to the laboratory for analysis.

Staging

Although every attempt should be made to minimize drum handling, drums must sometimes be staged (i.e., moved in an organized manner to predesignated areas) to facilitate characterization and remedial action, and to protect

drums from potentially hazardous site conditions (e.g., movement of heavy equipment and high temperatures that might cause explosion, ignition, or pressure buildup). Staging involves a trade-off between the increased hazards associated with drum movement and the decreased hazards associated with the enhanced organization and accessibility of the waste materials.

The number of staging areas necessary depends on site-specific circumstances such as the scope of the operation, the accessibility of drums in their original positions, and the perceived hazards. Investigation usually involves little, if any, staging; remedial and emergency operations can involve extensive drum staging. The extent of staging must be determined individually for each site, and should always be kept to a minimum. Up to five separate areas have been used (see Figure 11-5):

- An *initial staging area* where drums can be (1) organized according to type, size, and suspected contents, and (2) stored prior to sampling.
- An *opening area* where drums are opened, sampled, and resealed. Locate this area a safe distance from the original waste disposal or storage site and from all staging areas to prevent a chain reaction in case of fire or explosion.
- During large-scale remedial or emergency tasks, a separate *sampling area* may be set up at some distance from the opening area to reduce the number of people present in the opening area, and to limit potential casualties in case of an explosion.
- A *second staging area*, also known as a holding area, where drums are temporarily stored after sampling pending characterization of their contents. Do *not* place unsealed drums with unknown contents in the second staging area in case they contain incompatible materials. (Either remove the contents or overpack the drum.)
- A *final staging area*, also known as a bulking area, where substances that have been characterized are bulked for transport to treatment or disposal facilities.

  Locate the final staging area as close as possible to the site's exit.

  Grade the area and cover it with plastic sheeting.

  Construct approximately 1-foot-high (0.3-m-high) dikes around the entire area.

  Segregate drums according to their basic chemical categories (acids, heavy metals, pesticides, etc.) as determined by characterization. Construct separate areas for each type of waste present to preclude the possibility of intermingling incompatible chemicals when bulking.

In all staging areas, stage the drums two wide in two rows per area (see Figure 11-6), and space these rows 7 to 8 feet (2 to 2.5 m) apart to enable movement of the drum handling equipment.

Bulking

Wastes that have been characterized are often mixed together and placed in bulk containers such as tanks or vacuum trucks for shipment to treatment or disposal facilities. This increases the efficiency of transportation. Bulking should be performed only after thorough waste characterization by trained and experienced personnel. The preliminary tests described earlier under *Characterization* provide only a general indication of the nature of the individual wastes. In most cases, additional sampling and analysis to further characterize the wastes, and compatibility tests (in which small quantities of different wastes are mixed together under controlled conditions and observed for signs of incompatibility such as vapor generation and heat of reaction) should be conducted. Bulking is performed at the final staging area using the following procedures:

Crushed drums awaiting landfill. Note the staging of drums on the left in a row two drums wide.

- Inspect each tank trailer and remove any residual materials from the trailer prior to transferring any bulked materials. This will prevent reactions between incompatible chemicals.
- To move hazardous liquids, use pumps that are properly rated (see National Fire Protection Association [NFPA] 70 Articles 500-503 and NFPA 497M) and that have a safety relief valve with a splash shield. Make sure the pump hoses, casings, fittings, and gaskets are compatible with the material being pumped.
- Inspect hose lines before beginning work to ensure that all lines, fittings, and valves are intact with no weak spots.
- Take special precautions when handling hoses as they often contain residual material that can splash or spill on the personnel operating the hoses. Protect personnel against accidental splashing. Protect lines from vehicular and pedestrian traffic.
- Store flammable liquids in approved containers.

Shipment

Shipment of materials to offsite treatment, storage, or disposal facilities involves the entry of waste hauling vehicles into the site. U.S. Department of Transportation (DOT) regulations (49 CFR Parts 171-178) and EPA regulations (40 CFR Part 263) for shipment of hazardous

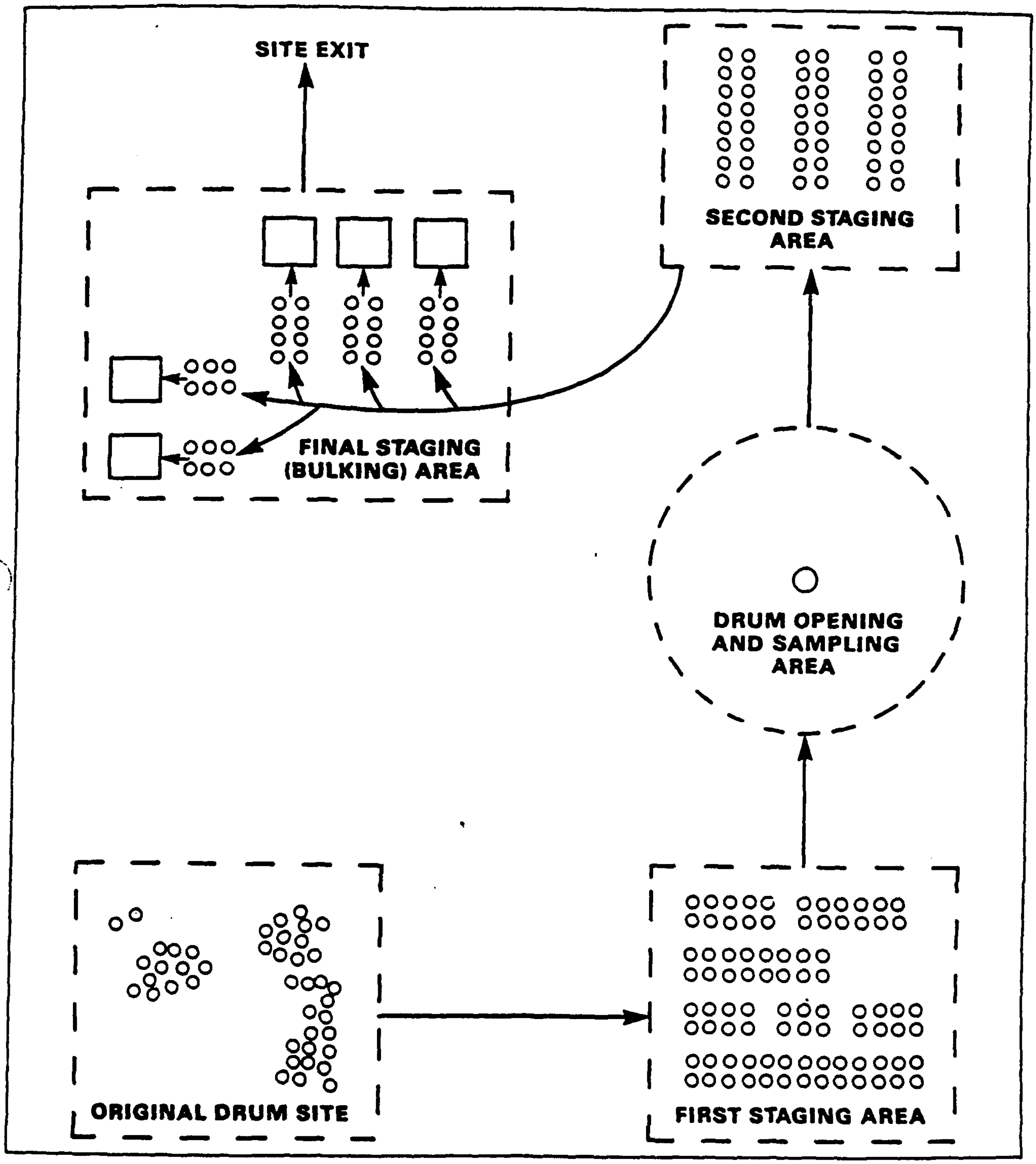


Figure 11-5. Possible Staging Areas at a Hazardous Waste Site.

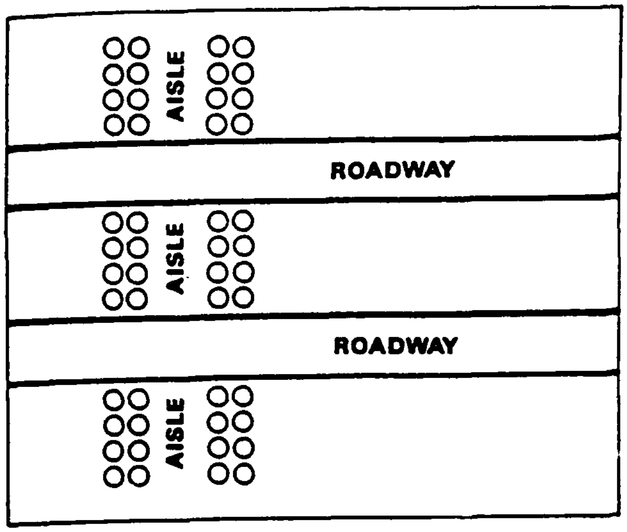
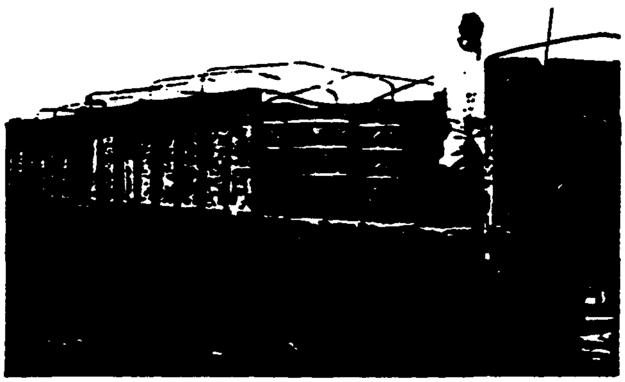


Figure 11-6. Sample Drum Staging Layout.
Source: Reference [1].



Single-stacked overpack drums awaiting transport off site. Worker suited in Level C personal protective equipment will spread a tarp over the drums to protect them during transport.

wastes must be complied with. The following guidelines can enhance the safety of these operations:

- Locate the final staging (bulking) area as close as possible to the site exit.
- Prepare a circulation plan that minimizes conflict between cleanup teams and waste haulers. Install traffic signs, lights, and other control devices as necessary.
- Provide adequate area for onsite and hauling vehicles to turn around. Where necessary, build or improve onsite roads.
- Stage hauling vehicles in a safe area until ready for loading with drivers remaining in cab. Minimize the time that drivers spend in hazardous areas.
- Outfit the driver with appropriate protective equipment.
- If drums are shipped, tightly seal the drums prior to loading. Overpack leaking or deteriorated drums prior to shipment. (Under most circumstances, overpack drums used for hazardous wastes may not be reused [49 CFR Part 173.3(c)]) Make sure that truck bed and walls are clean and smooth to prevent damage to drums. Do *not* double stack drums. Secure drums to prevent shifting during transport.
- Keep bulk solids several inches below the top of the truck container. Cover loads with a layer of clean soil, foam, and/or tarp. Secure the load to prevent shifting or release during transport.
- Weigh vehicles periodically to ensure that vehicle and road weight limits are not exceeded.
- Decontaminate vehicle tires prior to leaving the site to ensure that contamination is not carried onto public roads.
- Check periodically to ensure that vehicles are not releasing dust or vapor emissions off site.
- Develop procedures for responding quickly to offsite vehicle breakdown and accidents to ensure minimal public impact.

Special Case Problems

Tanks and Vaults

For tanks and vaults, which are often found on hazardous waste sites, the following procedures are recommended:

- In general, when opening a tank or vault follow the same procedures as for a sealed drum. If necessary, vent excess pressure if volatile substances are stored. Place deflecting shields between workers and the opening to prevent direct contamination of workers by materials forced out by pressure when the tank is opened.
- Guard manholes or access portals to prevent personnel from falling into the tank.
- Identify the contents through sampling and analysis. If characterization indicates that the contents can be safely moved with the available equipment, vacuum them into a trailer for transportation to a disposal or recycling facility.
- Empty and decontaminate the tank or vault before disposal.
- If it is necessary to enter a tank or vault (i.e., confined spaces) for any reason (e.g., to clean off solid materials or sludges on the bottom or sides of the tank or vault), the following precautions should be taken [4]:

  Ventilate thoroughly prior to entry.

  Disconnect connecting pipelines.

  Prior to entry, take air samples to prove the absence of flammable or other hazardous vapors and to demonstrate that adequate levels of oxygen exist.

Equip the entry team with appropriate respiratory protection, protective clothing, safety harnesses, and ropes.

Equip a safety observer with appropriate respiratory protection, protective clothing, a safety harness, and rope.

Establish lifeline signals prior tc entry so that the worker and safety observer can communicate by tugs on the rope.

Have an additional person available in the immediate vicinity to assist the safety observer if needed.

Instruct the safety observer not to enter the space until additional personnel are on scene.

Vacuum Trucks

- Wear appropriate protective clothing and equipment when opening the hatch.
- If possible, use mobile steps or suitable scaffolding consistent with 29 CFR Part 1910, Subpart D. Avoid climbing up the ladder and walking across the tank catwalk.
- If the truck must be climbed, raise and lower equipment and samples in carriers to enable workers to use two hands while climbing.
- If possible, sample from the top of the vehicle. If it is necessary to sample from the drain spigot, take steps to prevent spraying of excessive substances. Have all personnel stand off to the side. Have sorbent materials on hand in the event of a spill.

Elevated Tanks

In general, observe the safety precautions described for vacuum trucks. In addition:

- Use a safety line and harness.
- Maintain ladders and railings in accordance with OSHA requirements (29 CFR Part 1910, Subpart D).

Compressed Gas Cylinders

- Obtain expert assistance in moving and disposing of compressed gas cylinders.
- Handle compressed gas cylinders with extreme caution. The rupture of a cylinder may result in an explosion, and the cylinder may become a dangerous projectile.
- Record the identification numbers on the cylinders to aid in characterizing their contents.

Ponds and Lagoons

- Drowning is a very real danger for personnel suited in protective equipment because the weight of protective equipment increases an individual's overall density and severely impairs their swimming ability. Where there is danger of drowning, provide necessary safety gear such as lifeboats, tag lines, railings, nets, safety harnesses, and flotation gear.
- Wherever possible, stay on shore. Avoid going out over the water.
- Be aware that some solid wastes may float and give the appearance of solid cracked mud. Caution should be exercised when working along shorelines.

References

1. Mayhew, Joe J.; G.M. Sodear; and D.W. Carroll. 1982. A Hazardous Waste Site Management Plan. Chemical Manufacturers Association, Inc., Washington DC.

2. deVera, E.R.; B.P. Simmons; R.D. Stephens; and D.L. Storm. 1980. Samplers and Sampling Procedures for Hazardous Waste Streams. EPA-600/2-80-018. U.S. Environmental Protection Agency, Cincinnati, OH.

3. U.S. EPA. 1984. Characterization of Hazardous Waste Sites—A Methods Manual: Volume II. Available Sampling Methods. Second edition. EPA 600/4-84-076.

4. NIOSH. 1979. Criteria for a Recommended Standard: Working in Confined Spaces. NIOSH No. 80-106. Also available from U.S. Government Printing Office (#017-033-00353-0) and National Technical Information Service (PB-80-183015).

STANDARD OPERATING PROCEDURES FOR SAMPLING GROUNDWATER WITH HYDROPUNCH® I AND II SAMPLERS

1.0 OVERVIEW

The purpose of this Standard Operating Procedure (SOP) is to set procedures for the collection of groundwater samples using the HydroPunch® I and II samplers at McClellan Air Force Base (AFB). These guidelines will ensure that the groundwater samples are collected in a quality and consistent manner. This SOP is intended to be used in conjunction with Section 5.2 of the McClellan AFB Quality Assurance Project Plan (QAPP).

The HydroPunch® I and II samplers are used to collect groundwater samples from borings drilled to the top of the water table or at specific depths within a water bearing zone without installing a monitoring well. These samplers enable collection of groundwater quality data to: 1) identify the areas of contaminated groundwater and contributing source areas; and 2) enable more accurate placement of dedicated wells for long-term groundwater monitoring.

2.0 EQUIPMENT

HydroPunch® I and II samplers: The HydroPunch® samplers are constructed of stainless steel, approximately 5 feet long and up to 2 inches in diameter, and have internal sample chambers that can be used to collect and retrieve groundwater samples. Both samplers operate in the same manner in that both are driven into the soil with the aid of a drill rig, then retracted or pulled on to expose a screened inlet to the sample chamber. The primary differences between the HydroPunch® I and HydroPunch® II samplers are: 1) the HydroPunch® II sampler is larger in diameter (2 inches) than the HydroPunch® I (1.75 inches); and 2) the body of the HydroPunch® II sampler can be retracted as much as 4 feet from total driven depth to allow insertion of a 1-inch diameter bailer from the surface to collect unlimited sample volumes.

HydroPunch® samplers will be used in conjunction with many drilling methods including hollow stem auger (HSA), sonication, air rotary casing hammer (ARCH), cone

penetrometer (CPT), and other cased borehole methods to collect groundwater samples. The HydroPunch® I sampler, originally designed for use with CPT rigs, will be used to collect groundwater samples from borings drilled with a CPT rig. Because the HydroPunch® II is larger in diameter (2 inches versus 1.75 inches) than the CPT drill rods, it cannot be used with the CPT rig. However, the increased durability of the HydroPunch® II, the larger internal sample chamber (1250 ml versus 500 ml) and the added option of collecting samples from the HydroPunch® II with a 1-inch diameter bailer makes it particularly useful for remedial investigations in low yield water bearing zones. As a result, the HydroPunch® II will be used to collect groundwater samples from borings with all other cased drilling methods.

3.0 PROCEDURES

The following procedures will be used to collect groundwater samples using HydroPunch® samplers:

1. The anticipated depth to groundwater will be determined prior to drilling by measuring water levels in piezometers and monitoring wells that are screened through the water table (A zone at McClellan) and within 200 feet of the boring location. If no A zone wells are located nearby, quarterly water level measurements from the Groundwater Operable Unit quarterly monitoring program for wells in the general area will be used to estimate the depth to groundwater. This allows the geologist to anticipate the depth at which groundwater will be encountered. At sampling locations drilled with a CPT rig, the depth to water will be determined using a piezoelectric cone/tip during the initial penetration of CPT rods to evaluate borehole lithology.

2. For CPT borings, the HydroPunch® I sampler will be attached to the CPT drill rod and advanced to a depth of 5 feet below the estimated static water depth. Once at the prescribed depth, the sampler will be retracted 6 inches, to allow formation water to enter the sample chamber through the stainless steel screen. After approximately 30 minutes, the sampler will be removed and the sample decanted.

3. For all other drilling methods, the boring will be drilled to a depth approximately 5 to 10 feet above the depth first water is expected to be encountered. Drilling will then proceed at a reduced rate until collected soil samples indicate saturation.

4. Drilling will cease and drill tools (i.e., center bit, soil sampling tools, drill rods) will be removed from the boring and the HydroPunch® II sampler will be assembled.

5. The HydroPunch® II sampler will be connected to center rods and lowered to the boring total depth.

6. The sampler will be driven approximately 3 to 4 feet into the soils by applying downward pressure on the center rods using the drill rig (i.e., 140 pound drop hammer on HSA rig, vibrating head on sonic rig, etc.).

7. The body of the sampler will be pulled back the length into which it was driven into the ground, exposing 3 to 4 feet of polyvinyl chloride (PVC) or polypropylene (0.010 or 0.020 inch) slotted screen;

8. A water-level indicator will be lowered down the center rod to determine the height of water in the screened portion of the sampler as it fills. When an adequate volume of groundwater has flowed into the screen, the water-level indicator will be removed and a small diameter Teflon® bailer will be lowered into the screened portion of the HydroPunch® II to collect groundwater. This step will be repeated until sufficient groundwater has been collected for the required chemical analyses.

The following changes to operating procedure for the HydroPunch® II sampler shall be incorporated when lithologic deposits (i.e., clayey silts) that yield groundwater very slowly are present:

1. If the water level in the screen of the HydroPunch® II has not risen to a sufficient level for collection of a groundwater sample within 2 hours of

placement, then the sampler will be removed and the boring will be advanced an additional 5 feet (past the initial depth of the HydroPunch® II. Steps 4 through 8 will be repeated. If after 2 hours, sufficient groundwater has not entered the sampler, attempts to collect a groundwater sample will be discontinued.

Groundwater sample preservation and documentation: decontamination procedures for all downhole drilling and sampling equipment will be conducted in accordance with Section 5.2 of the QAPP.

STANDARD OPERATING PROCEDURE
FOR SAMPLING OF PERCHED WATER
AND INSTALLATION OF CONDUCTOR CASING
IN PERCHED WATER CONDITIONS

1.0 OVERVIEW

The purpose of this Standard Operating Procedure (SOP) is to set procedures for sampling of perched water and installation of conductor casing in perched water conditions.

The vertical migration of perched water in a remedial investigation soil boring provides two distinct environmental risks. First, if the perched water is contaminated and allowed to migrate vertically, it may further impact the groundwater at McClellan AFB. Second, uncontaminated perched water may leach contaminants present at greater depths within the vadose zone and provide a transport mechanism for contaminants to groundwater. Installation of a temporary conductor casing has proven to be an effective means of reducing this risk and allow drilling activities to continue.

Several drilling methods are employed during remedial investigations at McClellan AFB. These include hollow stem auger (HSA), sonication, air rotary casing hammer (ARCH), and cone penetrometer (CPT) drilling methods. With the exception of the HSA drilling method, all of these drilling methods basically involve the installation of a string of temporary threaded conductor casing or drill rods that effectively seal off successive lithologic intervals and water bearing zones as drilling proceeds. However, the configuration of the HSA auger flights (auger flights on the outside of the drill casing) results in a boring diameter that is several inches larger in diameter than the drill casing, and can create a pathway for vertical migration of perched water. As such, this SOP only addresses installation of conductor casing using the HSA drilling method.

2.0 EQUIPMENT

Only additional equipment used for the collection of perched water samples and installation of a temporary conductor casing are addressed here. Standard equipment

used in the collection of groundwater samples or in conjunction with drilling activities are described in Section 5.2 of the QAPP.

HydroPunch® I or II sampler/Teflon® bailer: A HydroPunch® II sampler will be used to collect perched/groundwater samples. A detailed descriptions of the HydroPunch® II sampler is available from QED Environmental Systems of Ann Arbor, Michigan.

Conductor casing: A temporary flush-threaded or welded steel conductor casing will be used to effectively seal off the perched water zone and allow drilling to proceed to greater depths. The conductor casing will be approximately 3 inches larger in diameter than the outside diameter of the auger flights.

Non-beneficiated sodium bentonite chips: Non-beneficiated sodium bentonite chips will be used to create a seal around the conductor casing.

3.0 PROCEDURES

Perched water sampling conducted during drilling will be accomplished using a HydroPunch® sampler or Teflon® bailer. An SOP for the collection of subsurface water samples through borings using HydroPunch® samplers from various drilling methods is included in this appendix. Other procedures for collection of groundwater samples using a bailer are addressed in Section 5.2 of the QAPP.

Prior to mobilizing to the drilling location, all information on the presence of perched water at the site and adjacent sites will be reviewed. This information may be available from previous CPT rig borings equipped with a piezoelectric tip/sensor or from other HSA borings drilled near the location. In the event that perched water is encountered at the site during drilling, the procedures outlined in this SOP will need to be followed. It is also important to note that utilization of this method limits the outer diameter of the auger flight used for subsequent drilling and sampling to 6-5/8 inches (3-1/4 inch I.D.). This is standard for most HSA rigs and allows collection of soil samples up to 2 inches in diameter.

1. If perched water is encountered while drilling, drilling activities will cease, and an attempt will be made to collect a water sample for analysis using either a HydroPunch® sampler (or equivalent) or a

Teflon® bailer. The decision of which sampler to use will be made in the field based on the volume of water present, with the HydroPunch® sampler being the preferred mechanism for collection. Samples will be analyzed for the contaminants of concern that are likely to be dissolved in water (VOCs, inorganic species) at the location.

2. If the depth and thickness of the perched water zone is known from review of existing information for the boring location, skip this step and proceed to Step 5. Otherwise, continuously sample until dry soils are retrieved and the depth and thickness of the perched water zone is identified.

3. When the total depth of the perched water zone has been identified, stop drilling, lift the augers 2 feet, emplace a 2-foot seal of non-beneficiated sodium bentonite chips at the total depth of the boring. This will create an effective seal prior to removing the augers and during reaming of the boring to a large diameter for conductor casing placement.

4. Ream the hole with a 10-1/8 inch O.D. auger to allow emplacement of a 8 inch O.D. conductor casing.

5. Following reaming to the bottom of the bentonite plug (see #3) or to the bottom of the perched zone as determined from previous drilling information, remove the augers and lower the conductor casing to the total depth of the boring.

6. Seat the conductor casing in place using the 140-pound rig hammer or use the weight of the rig (if necessary).

7. Use a one-inch tremie pipe to place an outer seal of non-beneficiated sodium bentonite chips/pellets in the annulus between the conductor casing and the borehole wall. The seal shall extend from the bottom of the casing to the depth of the top of the perched water zone. Also, pour bentonite chips into the inner annulus of the casing to create a one-foot thick plug at the base of the casing. Pour potable water down

the inner annulus and around the outside of the conductor casing to hydrate the bentonite.

8. Also, place several bentonite chips in a cup of water and allow to hydrate. Use this cup as a control sample to determine when bentonite in and around the casing is fully hydrated (may take up to two hours). Store the sample in a shaded area.

9. Continue drilling to greater depths through the interior of the conductor casing to total depth.

10. Following completion of the boring, abandon as required following procedures outlined in the QAPP.

11. Remove the temporary conductor casing when the level of the grout used for well construction or borehole abandonment reaches the base conductor casing.

STANDARD OPERATING PROCEDURE FOR RADIATION SURVEY AND FIELD ANALYSIS WITH GEIGER-MUELLER DETECTOR

1.0 OVERVIEW

The purpose of this standard operating procedure (SOP) is to establish procedures for rapid determination of alpha, beta, or gamma radiation in the field in either a survey or field analysis mode. Implementation of the SOP will:

- Expedite the identification of areas a few feet in diameter (within a large storage or use area) where radioactive wastes have penetrated the surface after a discharge;

- Allow analysis, equivalent to a Level III laboratory method, to be conducted in the field; and

- Save costs and time that would be expended in collection and laboratory analysis of large numbers of surface samples to identify radioactive discharge areas.

The use of this procedure is based on the ability of a detector to measure ionizing radiation given off by residual radionuclides in surface soils or pavement. The measurement of radiation is not affected by sample preparation or weather conditions. Therefore, accurate, precise, and representative measurements can be obtained in the field with the appropriate detector and rotameter. A Geiger-Mueller counter was selected for use in this procedure because it is very sensitive to alpha, beta, and gamma radiation.

Permission to bring low-level radioactive material on base for equipment calibration must be obtained from McClellan AFB prior to project initiation.

2.0 EQUIPMENT

Detector/Probe: A Geiger-Mueller counter, operating on the principal of gas amplification of radioactive energy entering the probe, is recommended because of sensitivity to low-level radiation. A survey probe held at waist-level while walking gridlines across the investigation area is recommended. A "pancake" probe placed in direct contact with the soil or pavement is recommended for in-field analysis of surface areas with "higher levels" of radiation identified with the survey probe. Other types of detectors may be selected if specific radionuclides or radiation types (alpha, beta, or gamma) are expected in the investigation area. The detector probe selected should be both sensitive and rugged enough for use in the field.

Scaler/Rotameter: A reliable, battery-operated, multi-scale meter with a voltage range and sensitivity suitable for operation with the selected detector. A calibration adjustment control and digital display are essential for in-field analysis.

Batteries: Backup batteries are recommended for in-field surveys. Most scaler/rotameters are designed to operate on C or D-cell batteries.

Calibration Standard: A low-level radioactive, calibration standard will be available for checking the detector and rotameter before collecting data. Obtain permission from McClellan AFB to bring the calibration standard on-base.

Data Records: Either data recording sheets or a field notebook must be available for documenting readings from the scaler/rotameter at designated intervals during the survey and during field analysis. In the survey mode, the location of the investigation area, equipment type and model, date, operator, grid size and spacing, calibration results, coordinates of measurement points, and digital readings should be recorded. In the analysis mode, additional information including multiple calibration points, multiple scale readings, and multiple measurements at the same point will also be recorded.

Health and Safety Plan: The Health and Safety Plan, particularly sections describing procedures to be followed in radiation source areas, must be available at the investigation area and understood by all field personnel.

3.0 PROCEDURES

To survey an investigation area to locate potential discharge areas having higher levels of radiation:

1. Determine if any radioactive materials are being stored or used in the investigation area; design the survey to allow a minimum 50-foot radial distance from the stored materials; if the surface beneath the stored materials is to be measured for radioactivity, the materials must be moved before the survey.

2. Establish the measurement grid across the investigation area; mark parallel traverse lines at a 3 to 5 foot-spacing across the site; mark a second set of lines, with the same spacing, perpendicular to the first set of lines; and assign unique numbers or letters to each line, such that the intersections of the lines have unique coordinates.

3. Assemble the survey detector/probe and the rotameter assuring that connections are secure; load fresh batteries.

4. Turn on the rotameter and allow to warm up for 1 to 2 minutes.

5. Check calibration of the rotameter relative to a radiation standards (supplied with the instrument) and adjust calibration, if necessary, following the instructions in the manufacturer's operating manual.

6. Check all scales on the rotameter to assure that all are responding to radiation.

7. Take 3 to 5 "background" readings on soil and pavement areas that are unlikely to have had radioactive material discharges; the average of these readings can be used to distinguish natural radiation from artificial discharges; record the readings and their locations.

8. Complete initial documentation on the data sheets including the calibration check and any adjustments.

9. The survey should be conducted by two persons, one carrying the instrument and taking readings, the second recording coordinate and rotameter measurements in counts per minute or milliroentgen per hour.

10. Begin the survey at the end of one of the grid lines with the rotameter set at its most sensitive range; the rotameter and probe should be held at a comfortable height near the waist so that a consistent height above the ground surface is maintained and the digital meter can be read easily at each survey point.

11. At the first point, determine if the rotameter is near its maximum reading on the most sensitive scale; if it is, increase the scale;

12. Continue along the one set of parallel lines taking and recording measurements at each intersection of lines; if the measurement at any point exceeds the scale maximum, change the rotameter to successively higher scales until the reading remains on scale.

13. If a measurement at any point exceeds the highest available scale, record the scale maximum value and the coordinates of the point, check the Health and Safety Plan to determine if the radiation level poses a health hazard.

14. Move backward along the line until the readings can be kept on scale; move to the opposite end of the grid line and begin taking measurements, approaching the point from that direction; stop taking readings along the line, if readings along the line exceed the maximum on the highest rotameter scale or if readings exceed those that pose a health hazard; move to one end of the next parallel grid line and begin taking readings.

15. When readings at each line intersection in the grid have been recorded, with the exception of areas exceeding the rotameter maximum or safe levels, check the instrument calibration.

16. Plot all readings collected on a sketch of the investigation area; attempt to draw isopleths of the readings to determine if there are any clusters of high readings.

17. Identify single or any clusters of points that yielded the greatest readings within the grid area; plan to collect field analysis measurements at those points or within any cluster; **exclude any areas in the grid where radiation exceeds safe levels defined in the Health and Safety Plan;** in the event that most of the readings in the grid are greater than 5 times the background average, collect field analysis measurements at 10% of all points within the grid.

To perform field analysis for radiation:

1. Identify and mark locations to be analyzed in the field.

2. Assemble the pancake Geiger-Mueller counter probe and the rotameter, assuring that connections are secure.

3. Load fresh batteries, and turn on the rotameter; allow to warm up for 1 to 2 minutes.

4. Check calibration with a radiation standard, and, if necessary, adjust according to the manufacturer's operating manual.

5. Record initial location and instrument data, including calibration data.

6. Take the instrument to a location outside of the grid area to be analyzed to collect background readings, even if this was done for a previous survey (Background readings are needed with the new detector/probe/rotameter configuration).

7. Place the pancake probe against the surface and take 3 successive readings at each of 3 to 5 background locations allowing the instrument to count for 60 seconds for each reading; adjust the scale of the rotameter to keep readings on scale; document the readings and

location; the average value of the readings are background values for this probe.

8. Move the instrument to the first marked location in the gridded area and record 3 successive readings after allowing the instrument to count for 60 seconds before recording the reading; adjust the scale of the rotameter to keep readings on scale; if the first reading cannot be kept on scale, record the maximum value for the instrument and move to a new sample location; record the 3 readings and coordinates of the location.

9. Repeat step 8 at all locations marked for analysis in the investigation area that were selected for field analysis.

10. After completing the field analyses in an investigation area, check the calibration of the pancake probe and rotameter and record the results on the data sheet.

11. Carefully document the specific locations and readings obtained from any locations at which readings exceeded the highest scale of the rotameter; report the locations to the Supervising Geologist and the Air Force Point of Contact.

STANDARD OPERATING PROCEDURE FOR CONE PENETROMETER TESTING

1.0 OVERVIEW

Cone penetrometer testing (CPT) will be used to evaluate the subsurface conditions at various sites on McClellan AFB. Cone penetrometer testing is a rapid and cost-effective method to determine soil characteristics based on differences in coefficients of friction among the various soil types that came in contact with the tip and a special friction sleeve on the rod during penetration. Depending on the penetrometer tool configuration, real-time measurements of tip and sleeve friction, conductivity, resistivity, and pore pressure can be recorded as the tool is pushed into the ground. The logs of these data can be correlated with lithology, similar to the use of boring and borehole geophysical logs, to interpret subsurface conditions. CPT is described in ASTM Standard D3441.

A CPT truck will be mobilized to the designed sampling location. The CPT test consists of smoothly pushing a small diameter, instrumented probe into the ground while a computer data acquisition system analyzes the soil response to penetration. The soil resistance to penetration, acting on the tip and along the sides of the penetrometer, is measured during CPT. The penetrometer is mounted at the downhole end of a string of sounding rods. A hydraulic ram is used to push the rod string and penetrometer into the ground at a constant rate of 4 feet per minute using a specifically-designed truck which can deliver up to 25 tons of force to the rod. Electronic signals from the penetrometer sensors are transmitted by a cable, strung through the hollow sounding rods, to a data acquisition and display computer system at the surface. It is anticipated that CPT measurements will be recorded from ground surface to 100 feet in depth. However, the total depth sounded at each location will be determined jointly by the Supervising Geologist and the CPT analyst and will be based on the geologic profile encountered in the hole and data needs identified in the field sampling plan.

In addition to determining subsurface geology, CPT sounding rods have been modified to allow for collection of soil gas and groundwater samples. HydroPunch® sampling will be used to assist the definition of the nature and extent of shallow groundwater contamination and to optimize the placement of additional permanent monitoring or extraction wells. Several CPT firms have also engineered downhole soil and soil gas

sampling systems. To meet the needs of the remedial investigation, a modified CPT rig capable of collecting soil, soil gas, and groundwater samples will be needed.

2.0 EQUIPMENT

Cone Penetrometer Rig: Cone penetrometer testing will be conducted using a 25-ton CPT rig, capable of penetrating soils at OU C to depths of 110 feet. The rig will be configured to allow for collection of discrete downhole soil, soil gas, and groundwater samples, as well as continuous subsurface lithologic data.

HydroPunch® I Sampler: A HydroPunch® I or equivalent sampler will be used to collect groundwater samples using the CPT rig.

3.0 PROCEDURES

Prior to initiation of the testing, the Contractor and the selected subcontractor will conduct CPT adjacent to an existing monitoring well to "calibrate" the penetrometer sensor response to the soil logged borehole. This "calibration" will consist of a comparison of the logs generated by both methods and will allow for enhanced geologic interpretation through cross-section generation using both types of logs. Calibration provides control for the CPT data so an accurate evaluation of the subsurface can be made. The well will be chosen using the following criteria:

- Representativeness of soil types in OU C;
- Total depth; and
- Quality of the soil boring log.

HydroPunch® samples will be collected using procedures outlined in the HydroPunch® I and II SOPs included in this appendix.

Soil gas sample collection techniques vary by CPT firm and site data quality objectives. The specific procedure to be used will be documented by the OU C RI/FS

contractor for review by the Air Force and regulatory agencies prior to the start of field activities.

Decontamination of the downhole equipment will be accomplished by passing the sounding rods through a rod washing chamber, mounted at the bottom of the hydraulic ram assembly, as they are being retrieved. High pressure steam is used to clean soil and groundwater from the exterior of the downhole equipment. Rubber seals at the top and bottom of the rod washing chamber serve both to prevent decon water from leaking to the ground surface, and to scrape off soil smeared on the surface of the downhole equipment. Decon water will be collected and stored prior to determination of the appropriate disposal location.

A grouting system will be used to seal off the boring left after completion of each penetrometer sounding. A neat cement/bentonite grout slurry will be prepared following the specifications outlined in the QAPP. The specified mixture will be pumped through the sounding rods into the hole. After each 10-foot section of sounding rod is lifted out of the boring and removed, sufficient grout will be pumped through the sounding rod string to fill the bottom 10 feet of the open borehole. About 3/4 gallons of grout are required to seal 10 feet of penetrometer boring. Grout will be continuously placed from total depth to the ground surface. All CPT locations will be checked within 24 hours to observe if grout has settled; if it has, additional grout will be added to the CPT hole. The location will then be checked after each 24-hour period until the grout remains flush with the ground surface.

STANDARD OPERATING PROCEDURE FOR IDENTIFYING AND TAKING ACTION FOR NON-AQUEOUS PHASE LIQUIDS DURING SUBSURFACE DRILLING

1.0 OVERVIEW

This SOP describes methods to be used to identify and take action for non-aqueous phase liquids that may be encountered during subsurface drilling activities. Non-aqueous phase liquids (NAPLs) are accumulations (films or pools) of petroleum hydrocarbons or halogenated organic compounds that have not been dissolved in groundwater because the liquid is immiscible or only slightly soluble in water. After NAPLs have been identified, it is important to take actions that will enhance remedial action and avoid vertical movement. Inducing vertical movement of these liquids could spread high concentrations of contaminants to uncontaminated or less contaminated soils and disperse the liquid pool making it difficult to find for remedial action.

The procedure includes: identifying NAPLs in subsurface soils or groundwater with ultraviolet (UV) fluorescence equipment or a hydrophobic dye (Sudan IV); halting drilling to prevent deeper vertical movement of the NAPL; grouting the boring or completing as a soil vapor extraction (SVE), or bioventing well; documenting the occurrence; and marking the boring or well location for additional investigation or remediation.

2.0 EQUIPMENT

The following equipment should be available for identifying and preventing the spreading of NAPLs in soil or water:

- Grouting equipment and supplies to mix and place grout in accordance with specifications in Section 5.2.8 of the QAPP;
- Calibrated OVA to screen for VOC or hydrocarbon concentrations >500 ppm in soil gas;

- Ultraviolet light with broad spectrum bulb to scan shortwave and longwave UV simultaneously (see Section 4.0 of this SOP);

- Light-sealed, "black" bag or box to allowing viewing samples under UV light only; and transparent polyethylene bags; <u>or</u>

- Sudan IV dye powder to stain organic liquids red on contact; and 50 milliliter polypropylene vials, tapwater, and a small stainless steel spatula (see Section 4.0, Principles and Sensitivities). **Caution: dye is an eye irritant/mutagen. The power should be handled in a well ventilated area and gloves must be worn. Refer to the OU C Health and Safety Plan (forthcoming) for the proper handling procedures.**

3.0 PROCEDURE

While drilling borings in locations near identified leaky tanks, sumps, pipelines, or disposal pits that may have contained undissolved solvent or petroleum hydrocarbon liquids, take the following steps:

1. Monitor soil gas concentrations on core samples with a calibrated photoionization detector (PID) in accordance with procedures in Section 5.8 of the QAPP.

2. If PID readings exceed 500 ppmv or if hydrocarbon odors are evident, stop drilling and select a representative sample of the core (Note: finer-grained intervals in the core are more likely to retain liquid hydrocarbons). Collect an additional, undisturbed sample. Package and label as specified in the QAPP. Hold the sample on ice until total boring depth is reached. Randomly select 25% of these samples and send for off-site confirmational analyses of volatile contaminants of concern.

3a. If the UV light and black bag/box are to be used: place the core sample in a polyethylene bag; seal the bag; squeeze the sample to force any liquid to the outside of the sample, against the bag; insert the sample

bag in the black bag/box; turn on the UV lamp; and examine sample for evidence of fluorescence. Go to 4a.

3b. If the Sudan IV dye is to be used: with the spatula, loosely fill half of the 50 mL polypropylene vial with finer-grained soil from the core; add clean tapwater to the vial until it rises slightly above the soil in the vial; close the end of the vial and shake it vigorously for 10 to 15 seconds; add 2 milligrams (the amount that can be transferred on the side of a flat toothpick) dye powder; close the vial; shake the vial vigorously for 20 to 30 seconds; and examine the liquid for red staining. Go to 4b.

4a. If the liquid squeezed from the sample uniformly fluoresces under the light of the UV lamp, inform the driller that the boring will be terminated immediately and to prepare for grouting or construction of a SVE or bioventing well. Go to 5.

If the liquid from the sample has very weak or spotty fluorescence, continue drilling, but monitor each subsequent core interval by repeating steps 3a and 4a.

4b. If the liquid above the soil in the vial has a dark red or brown stain, inform the driller that the boring will be terminated immediately and to prepare for grouting or construction of a SVE or bioventing well. Go to 5.

If the liquid shows only a weak red or no stain, continue drilling, but monitor each subsequent core interval by repeating steps 3b and 4b.

5. Accurately determine the depth from which the sample was collected, with a weighted engineer's tape; document the depth, the sample lithology, and the results of the NAPL test (Specify the method, equipment, and indicator used to make the decision.).

6. Decide if the boring will be grouted or prepared for construction of a SVE or bioventing well. Use an established Boring Conversion

Decision Diagram (for example, OU C SAP Figure 4-9) or Consensus Statement and discuss with Air Force.

Grout the boring in accordance with the grout mix and procedures specified in Section 5.2.8 of the QAPP, or construct a well in accordance with specifications in Standard Operating Procedures for Soil Vapor Extraction Well Construction.

7. Collect a sample of the soil that was used in the NAPL testing and prepare to send the sample for analysis to identify the NAPL. Follow standard sample packaging and transport procedures in the QAPP. **Note: Indicate on the chain-of-custody that the sample may contain very high concentrations of fuel hydrocarbons or halogenated organic compounds.**

8. After grouting or well construction is complete, accurately measure the surface location from permanent landmarks.

9. Document in the field notebook and the drilling log the identification of NAPL, the decision to terminate the boring, the details of grouting or well construction, and the geographic location and depth of the NAPL.

4.0 PRINCIPLES AND SENSITIVITY

4.1 Fluorescence

Fluorescence occurs in crude oils and petroleum products (except saturated aliphatic compounds such as paraffin) as a result of excitation by ultraviolet radiation; high concentrations of aromatic compounds increase fluorescence. Unsaturated aliphatic hydrocarbons, such as trichloroethene and tetrachloroethene also fluoresce; carbon tetrachloride and dichloromethane do not. Ultraviolet fluorescence has been used in the petroleum industry for decades to identify hydrocarbons in drill mud, cuttings, and core.

Separate phase NAPLs occurring in soils at saturations of 1% to 23% were detectable by fluorescence in 42 of 45 samples in testing by Cohen and others (1992)[1].

4.2 Sudan IV Dye

Sudan IV is a dye that causes organic liquids to turn red on contact. It has been used to colorize NAPLs in flow experiments (for example, Schwille). In testing by Cohen and others (1992), NAPLs in soil at saturations of 1% to 25% were detected in 41 of 45 samples. Refer to the OU C Health and Safety Plan (forthcoming) for the proper handling procedures of the dye.

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[1] Cohen, R.M., A.P. Bryda, S.T. Shaw, and C.P. Spalding, 1992. Evaluation of Visual Methods to Detect NAPL in Soil and Water: Groundwater Monitoring Review, Volume XII, No. 4, p. 132.

STANDARD OPERATING PROCEDURES FOR SAMPLING SOIL GAS FROM DRY GROUNDWATER MONITORING WELLS

1.0 OVERVIEW

The purpose of this standard operating procedure (SOP) is to establish procedures for sampling soil gas from dry groundwater monitoring wells at McClellan Air Force Base (AFB). These guidelines will help ensure quality and consistency in sample collection. This SOP is intended to be used in conjunction with Section 5 (field procedures) of the McClellan AFB Quality Assurance Project Plan (QAPP).

Soil gas samples may be collected from dry groundwater monitoring wells by modifying the groundwater sampling vehicle. A reversible modification of the groundwater sampling vehicle equipment will speed up well purging, limit the volume of soil gas released, and provide an alternate use for the equipment. By using the sampling vehicle packer, only the soil gas passing through the screened interval of the well will be purged and sampled. Sampling of soil gas in the well will be done in the same manner as a soil gas monitoring well.

2.0 EQUIPMENT

Equipment required to perform soil gas sampling with the sampling vehicle from dry groundwater monitoring wells includes:

- Electrical generator (gasoline powered) to operate a vacuum pump.
- Vacuum pump to purge the well.
- Rotameter to measure flow rate.
- Downhole packer with top fitting to attach 0.25-inch Teflon® sampling tubing.

- Sufficient Teflon® tubing (0.25-inch diameter) to extend from the vacuum pump to the top of the packer (discard tubing after each well is sampled and place in the contaminated materials bin in the contractor's staging area).

- Sample containers (e.g., stainless steel evacuated canisters, syringes, tedlar bags, etc.).

3.0 PROCEDURES

1. Move sampling vehicle to the well and set up over the well in the same manner as if groundwater were being sampled; open the well; and remove the cap on the casing.

2. Monitor soil gas at the wellhead with a photoionization detector (PID).

3. Depending on PID readings, follow procedures for protection of sampler's health and safety described in the McClellan AFB Health and Safety Plan.

4. With a groundwater sounder, determine if there is water in the screen interval of the well; if water is present, determine the length of well screen that is above the saturated zone; the "dry" well screen length is used in the calculation of gas purge volume.

5. Attach teflon line to the top of the downhole packer and lower the packer to a depth 3 feet above the well screen, and inflate packer.

6. Attach upper end of teflon line to flowmeter and any gas sampling equipment.

7. Determine the gas purge volume in the casing between the bottom of the packer and groundwater or the bottom of the well, if no water is present; multiply the gas purge volume by 2 to determine the Total Purge Volume of soil gas that will be removed before sampling.

8. Start the vacuum pump and determine the flow rate of gas through the pump; when the flow rate has stabilized; divide the Total Purge Volume by the rate to determine the total purge time.

9. Monitor the gas exhausted from the vacuum pump with the PID (Vapor concentrations may increase during the removal of gas from the well.); follow health and safety procedures as in Step 3.

10. After the Total Purge Volume has been removed, follow procedures for sampling of soil gas monitoring wells in Section 5.10.3 of the McClellan AFB QAPP.

11. Deflate packer and raise the packer and sample tubing to the surface; remove the teflon tubing and store for subsequent disposal.

12. Recap and secure the well; move to the next well.

STANDARD OPERATING PROCEDURES FOR CONDUCTING MAGNETIC AND ELECTROMAGNETIC SURVEYS

1.0 OVERVIEW

The purpose of this standard operating procedure (SOP) is to establish procedures for conducting magnetic and electromagnetic geophysical surveys at McClellan Air Force Base (AFB). The primary objective of these surveys is to locate buried drums within former disposal pits. The methods will also be used to identify the location of underground storage tanks. Magnetic and electromagnetic methods are both appropriate for locating buried metal objects; however, each method by itself cannot be used conclusively for this purpose. Therefore, both methods will be conducted in conjunction to maximize confidence in identifying locations of buried drums. Each method has distinct advantages: magnetics can be used to locate deeper targets than electromagnetics (i.e., greater than 15 feet); however, magnetics is more affected by other metallic interferences (e.g., utilities, metal in buildings, etc.). Electromagnetics also has the ability to detect chemicals or contaminant plumes (e.g., hydrocarbons in high concentrations, or other conductive or resistive chemicals).

Magnetometer surveys consist of measuring variations in the earth's magnetic field; magnetic gradient is measured to accurately locate buried ferrous objects such as drums. Measurement results indicate areas of anomalous magnetic field strength; location and depth of the buried object can be inferred from the shape and width of the anomaly.

The electromagnetic method measures the electrical conductivity of a volume of earth, which is a function of soil or rock type, porosity/permeability, and fluid content. The measured values, referred to as terrain conductivity, are obtained without direct ground contact, through electromagnetic induction. Measurements taken along traverses or in a grid pattern delineate lateral variations in terrain conductivity, which are used to map the location of buried metallic objects. Electromagnetic methods are used to qualitatively map lateral variations at shallow depths; depth or thickness determination cannot be made solely by this method.

2.0 EQUIPMENT

Magnetics

A magnetic gradiometer (EPA OMNI IV®) will be used to obtain both total field and vertical magnetic gradient data. This instrument has an absolute accuracy of 1 gamma (g) and a processing sensitivity of 0.02 g. It contains two sensors mounted 0.5 meters apart at the top of an 8-foot staff. The reading obtained from the top sensor represents the total intensity of the earth's magnetic field in gammas. The difference between the top and bottom sensors represents the vertical gradient in gammas per meter. The instrument has built-in software and a nonvolatile memory. It automatically computes the total field and vertical gradient values in real time. These data are stored in memory along with the time and date of the reading, as well as corresponding grid line number and station position.

The magnetic gradiometer is characterized by high sensitivity, noise rejection, and signal discrimination, which allow optimum rejection of temporal fluctuations and regional effects, and provide maximum sensitivity to near-surface (0–20 feet) sources and optimum spatial resolution. The measurements require no corrections for diurnal variation, micropulsations, and magnetic storms. Gradient measurements also provide vector direction as well as magnitude and can be used for more quantitative determination of anomaly location, depth, and shape.

Electromagnetics

A ground conductivity meter (Geonics Ltd. EM-31DL®) will be used to obtain terrain conductivity data. The transmitting and receiving coils on this instrument are mounted at the ends of 4-foot long tubes that project horizontally from either end of the instrumentation console. The 8-foot coil separation results in a depth of penetration of approximately 15 to 18 feet. A data logger will be used to record quadrature and in-phase data at each measuring station.

3.0 PROCEDURES

The following procedures will be used to conduct magnetic and electromagnetic geophysical surveys:

1. Existing site data (geologic and historical) will be reviewed to help plan the survey.

2. Survey objectives will be defined.

3. Survey grid layout (spacing) will be designed based on site conditions (e.g., target size; the closer the grid lines are spaced, the better the resolution and the better the probability of detecting anomalies). For the purposes of locating buried drums, a 10- to 20-foot grid line spacing will be used.

4. Grid lines will be surveyed using compass and distance wheel, and then marked with numbered reference stakes.

5. Magnetic/electromagnetic measurements are taken by placing the instrument at a predetermined station, ori ing the instrument properly, and taking the reading in accordance with the operating instructions for the particular instrument used. (The instrument operator should be free of any magnetic material such as keys, belt buckles, steel-toed shoes, etc.) The instrument will be held at the same height above the ground for each measurement.

6. For the magnetic gradiometer, the instrument will be programmed to record both total field and vertical gradient magnetic data, along with station coordinates.

7. Measures will be taken to mitigate excessive noise by avoiding possible noise sources (fences, power lines, vehicles, etc.); if unavoidable, noise sources will be documented on the data logger, and any potential impacts will be evaluated by a registered geophysicist.

8. Field notes regarding locations of the measurement points relative to grid line markers will be kept.

9. At the end of each day, data will be downloaded to a portable computer; data will be backed up on a floppy disk and printed out in hard copy form (for electromagnetic terrain conductivity, instrument response data will be reduced to units of conductivity in milliSiemans per meter [quadrature] and parts per thousand [in-phase]; variations in sensitivity that occur in areas of high conductivity will also be corrected).

10. At the completion of the survey, data will be collected and contoured using contouring software (for magnetics, both total field and vertical gradient contour maps will be produced; for electromagnetic terrain conductivity, both quadrature and in-phase contour maps will be produced).

11. The in-phase terrain conductivity contours will be compared with the magnetic contours to determine the most likely locations of buried drums or other disposal debris.

STANDARD OPERATING PROCEDURES
FOR SAMPLING SEDIMENTS IN
PONDS OR IMPOUNDMENTS

1.0 OVERVIEW

The purpose of the Standard Operating Procedure (SOP) is to establish procedures for the collection of sediment samples in ponds or surface impoundments at McClellan Air Force Base (AFB). These guidelines will help ensure quality and consistency in sample collection procedures. These procedures will be followed in conjunction with other documentation and recordkeeping procedures described in Sections 5.0 and 6.0 of the McClellan AFB Quality Assurance Project Plan (QAPP).

2.0 EQUIPMENT

Sediment samples from ponds or surface impoundments will be collected using a Ponar dredge (see Figure 5-26 of the McClellan AFB QAPP), which is a clamshell-type scoop activated by a counter-lever system. The Ponar dredge will be either approximately 6 by 6 inches or 9 by 9 inches in dimensions and weighs approximately 30 to 40 pounds. The dredge has side plates and a screen on top of the sample compartment to prevent sample loss during closure. The shell is opened, latched in place, and slowly lowered to the bottom; when tension is released on the lowering cable, the latch releases and the lifting action of the cable on the lever system closes the clamshell. Because the dredge is a grab sampler, it is not capable of collecting undisturbed samples. The sampling action of the devise may cause disturbance of the sediments that can be minimized by allowing for a very slow contact with the bottom of the pond.

In addition to the Ponar dredge, other equipment to be used in sediment sampling from ponds will include a 12-foot long aluminum row boat from which to collect the samples, nylon rope or cord from which to suspend the dredge and line up sampling locations (i.e., across the ponds), and a compass and measuring wheel with which to locate sampling points.

3.0 PROCEDURES

The following procedures will be used to collect sediment samples from ponds or impoundments:

1. Sampling locations are previously determined in the sampling plan.

2. Locate sediment sampling points within the pond or impoundment by measuring and marking (using compass, measuring wheel, and labeled stakes) grid lines along the sides of each pond to be sampled (i.e., along the east-west axis [northing coordinate] and the north-south axis [easting coordinate]), followed by stringing a nylon rope or line across the pond in both directions and securing to the stakes on each side of the pond, creating an intersection of the two lines (i.e., the sampling point).

3. Load sampling equipment (i.e., Ponar dredge, stainless steel mixing bowl and spoon, sample jars, cooler, etc.) onto the 12-foot long aluminum row boat; the boat is then rowed to the sampling location (i.e., the intersection of the two reference lines).

4. Attach a precleaned Ponar dredge to the necessary length of sample line (e.g., a solid braided 3/16-inch nylon line).

5. Tie the free end of the sample line to a fixed support on the boat to prevent accidental loss of the sampler.

6. Open the Ponar sampler jaws until latched, and slowly lower the dredge to the bottom to avoid disturbing lighter bottom sediments.

7. Measure and mark the distance to the top of the sediment on the sample line; record the depth to the top of the sediment.

8. Ease the sample line tension (i.e., allow to slack about an inch) to release catch mechanism on jaws.

9. Raise dredge to enable lever system to close jaws, and slowly bring to the surface.

10. Place Ponar into a stainless steel tray and open to release sediments (approximately 1/4 to 1/2 cubic foot of sediment); remove Ponar.

11. Homogenize sediments in a stainless steel metal bowl and transfer to sample bottles using a stainless steel spoon.

12. Complete the necessary paperwork (e.g., sample description, samplers, date and time, chain-of-custody form, etc.), label and store bottles, and decontaminate equipment as required in the McClellan AFB QAPP.

STANDARD OPERATING PROCEDURE
TRENCHING

1.0 OVERVIEW

The purpose of this Standard Operating Procedure (SOP) is to set procedures for trenching in disposal pits, landfills, and preexisting ponds/creeks at McClellan Air Force Base (AFB). These procedures will be followed in conjunction with other documentation and record keeping procedures outlined in Section 5.2 of the McClellan AFB Quality Assurance Project Plan (QAPP).

A presurvey will be conducted by geophysical methods to determine locations of any underground utilities and/or buried drums.

2.0 EQUIPMENT

CAT 235 Hydraulic Excavator or equivalent: For use in excavation of test pits/trenches which exceed 20' maximum depth. Excavators shall be equipped with 24" buckets and enclosed operator cabs. Operator cabs shall be outfitted with the capability to provide self-contained breathing apparatus for IDLH type environments. For excavation in areas of wet or soggy conditions, excavators shall be equipped with low ground pressure (LGP) tracks to reduce sinking.

CAT 225 Hydraulic Excavator or equivalent: For use in excavation of test pits/trenches with a maximum depth of 20' or less. Excavators shall be equipped with 24" buckets and enclosed operator cabs. Operator cabs shall be outfitted with the capability to provide self-contained breathing apparatus for IDLH type environments. For excavation in areas of wet or soggy conditions, excavators shall be equipped with low ground pressure (LGP) tracks to reduce sinking.

Shoring: If test pits/trenches show signs of failure, sloughing, caving, or other distress symptoms, the hazardous waste operations and emergency response standard in 29 CFR 1910.120 (OSHA) shall be implemented to ensure the excavation remains open and safe during data gathering and/or visual assessment activities. Shoring shall be installed at

properly spaced intervals as determined by soil lithology, excavation depth, vegetation cover, proximity to structures or underground utilities, and subsurface obstacles encountered. Determination of the need for shoring shall be made on a case-by-case basis in the field by the site engineer/geologist overseeing excavation activities. No personnel shall enter the trench.

Backfill and Compaction: Backfill and compaction of test pits/trenches shall be accomplished using an excavator or suitably sized front-end loader. Placement shall be conducted in appropriately sized lifts to ensure proper compaction. Compaction to 95% shall be accomplished by use of a hydraulically controlled vibratory plate compactor connected to an excavator. Compactive effort shall be determined using a nuclear density gauge in conjunction with soil results from ASTM-D-698 to ensure all areas within the excavation receive adequate surface pressure during placement and compaction.

Downhole video camera/video tapes: A battery operated (rechargeable) 8MM video camera equipped with a spotlight will be used to record lithologic information (fill versus native materials) to the base of the trench. The camera will be weather resistant, mounted within a steel frame, and attached to two 10 foot lengths of 1 inch polyvinyl chloride (PVC) pipe.

Video monitor/tapes: A color video monitor will be used to view the subsurface lithology either as recording proceeds or immediately after recording to aid in decision-making while in the field.

Steel Measuring Tape: A 1-inch wide by 25-foot long steel measuring tape will be used to determine trench depth and length during excavation and to measure video camera depth during recording. Markings of depth will also be made on the PVC pipe for estimations of camera depth at the surface.

Rectangular Gridded Paper or Logbook: A rectangular gridded logbook or sheets of bound gridded paper will be utilized to create plan view and cross sections of the subsurface geology as trenching proceeds.

3.0 PROCEDURES

The following procedures will be used to determine site boundaries through trenching:

1. Prior to the start of trenching activities, mark the traverse that will be followed using 3-foot long wooden stakes. In addition, all underground utility or process lines that may be encountered will have their locations determined and marked and the proper digging permit signed off on prior to excavation.

2. Collect a soil sample for physical property analysis by ASTM-D-698 to support compaction tests.

3. Using a CAT 235 or equivalent equipped with a 24-inch bucket, trench to a depth of approximately 5 feet along a 50-foot span of the trench. Record concentrations of volatile organic compounds with a photoionization detector (PID).

4. If drilling in pits or landfills, determine the presence of methane gas and the potential for explosion using a PID with a flame ionization detector (FID) and a combustible gas indicator (CGI) at the surface and along the length of the trench. PID, CGI, and FID readings that raise health and safety concerns will be identified in the RI contractor's Health and Safety Plan prepared for this investigation.

5. Map native or fill material observed at the surface or in the trench; measure distances and record in the field logbook or on gridded paper.

6. Continue trenching, take instrument readings and map the subsurface at 5-foot depth increments along the full length of the trench to: a) the depth identified in the field sampling plan (maximum of 20 feet) for the site; b) the depth where the base of the original landfill, pit, or preexisting pond is identified in the subsurface through visual observation/instrument readings; or c) the top of a perched water zone.

Under no circumstances will trenching activities be allowed to continue to depths greater than the top of an identified perched water zone.

7. At depth intervals of 10 feet, begin recording the subsurface geology and any evidence indicating the surface of pit, landfill, or pond with the video camera at 20 foot intervals along the trench and used as a depth marker/reference during video taping.

8. Backfill excavated material and compact the material in the trench.

9. Continue steps 2 through 8 as required to meet the objectives of the field sampling plan.

When field personnel are not present at the site, the trench will be taped off and protected with night-flashing safety barriers according to requirements established by OSHA or the U.S. Army Corps of Engineers, whichever is more stringent.

Documentation for each excavation shall be the responsibility of the field task leader. At a minimum, the following information will be documented in detail:

- Name and location of job;
- Date and time excavation started and stopped;
- Approximate surface elevation;
- Total depth of the excavation;
- Dimensions of the pit;
- General geologic descriptions and descriptions of any foreign material, visual staining, or odors. If buried drums are encountered, see the SOP for excavation and sampling of buried drums;
- Types of instruments for monitoring;

- Organic vapor. methane, and oxygen concentrations;
- Depth to perched water (if encountered);
- Photographs;
- Cross section through the trench (from video or visual mapping) indicating depth of fill/native material; and
- Plan view of map of trench and nearest undisturbed soil.

**STANDARD OPERATING PROCEDURE
FOR ANALYZING SOIL SAMPLES
USING IMMUNOASSAY TEST KITS**

As test kits vary by manufacturer, the Standard Operating Procedure will be prepared for Air Force and regulatory agency review by the OU C RI/FS contractor prior to start of field activities.

STANDARD OPERATING PROCEDURE
FOR THE DETECTION OF VINYL CHLORIDE IN SOIL GAS SAMPLES

The methodology for detection of vinyl chloride in soil gas samples is currently under development. A Standard Operating Procedure for this method will be prepared for Air Force and regulatory agency review by prior to start of field activities.

STANDARD OPERATING PROCEDURE
FOR ANALYSIS OF SAMPLES USING A MOBILE LABORATORY

A Standard Operating Procedure for analysis of samples (by method) using a mobile laboratory will be prepared for Air Force and regulatory agency review by the OU C RI/FS contractor prior to start of field activities.

STANDARD OPERATING PROCEDURE
FOR ANALYSIS OF SAMPLES USING A PORTABLE GAS CHROMATOGRAPH

A Standard Operating Procedure for analysis of samples using a portable gas chromatograph will be prepared for Air Force and regulatory agency review by the OU C RI/FS contractor prior to start of field activities.

STANDARD OPERATING PROCEDURE FOR THE DETECTION AND MITIGATION OF HAZARDS FROM METHANE GAS

A Standard Operating Procedure for detection and mitigation of hazards resulting from methane gas detected in borings and trenches will be prepared for Air Force and regulatory agency review by the OU C RI/FS contractor prior to start of field activities.

APPENDIX C

Response to Comments on Draft OU C RI SAP

EPA
General Comments

1. *Comment summary: Boundaries of the Study are restrictive and do not allow for the support of elements set forth in the Decision Rule in some of the Data Quality Objective Tables.*

Response: The Boundaries of the Study have been changed to support the Decision Rule.

2. *Comment summary: Criteria or rationale for selecting physical parameter sampling locations should be provided.*

Response: The criteria and rationale have been added to Section 4 of the Draft Final OU C SAP.

3. *Comment summary: Physical parameter sampling locations should appear in both the Field Sampling Plan text and on the Sampling and Analysis Matrix Tables.*

Response: Physical parameter sampling locations are discussed in the text and are noted on the Matrix Tables.

4. *Comment summary: Ground penetrating radar and magnetometer surveys are proposed for identifying buried stream channels. What are the criteria for using these techniques and how will the generated data be utilized?*

Response: The sampling strategy for the buried creekbeds has been changed: ground penetrating radar and magnetometer surveys are no longer recommended for identifying buried stream channels. Buried stream channels will be identified in trenches dug across the former stream location (as identified on aerial photographs). Magnetometer and electromagnetic surveys will be used to identify buried drums and cylinders and to identify underground tank locations, where necessary. A Standard Operating Procedure for these geophysical surveys has been added to Appendix B.

5. *Comment summary: It would be appropriate for each individual Field Sampling Plan to include a section stating the proposed drilling method for each proposed boring location.*

Response: The drilling method used for borings will be determined by the RI contractor. The contractor has not yet been determined. Drilling options, including pros, cons, restrictions, and limitations of the options, are discussed in Section 5.

6/7. Comment summary: Well purging procedures stated in the QAPP are not adequate.

Response: These comments will be forwarded to personnel responsible for updates to the QAPP. These issues have not be addressed in the SAP.

8. Comment summary: Data quality objective tables for decision making should include analytical data quality as a source of uncertainty where applicable.

Response: Analytical data quality has been added to the tables as a source of uncertainty where appropriate.

9. Comment summary: The field gas chromatograph analytical method should be stated. Include the sample collection procedure for Method TO-14. State the benefit and uses of Method TO-14 in the evaluation of the field analytical method.

Response: Standard Operating Procedures (SOPs) for the field gas chromatograph will be prepared by the RI contractor, once chosen. The method will depend on the equipment selected to perform the analyses. Sample collection procedures for Method TO-14 will also be included in a SOP as this will depend on the drilling and sampling equipment used. Method TO-14 is a confirmational method used to identify false positives, false negatives, and compounds not on the standard analyte list.

10. Comment summary: Each Field Sampling Plan should list previous investigation data and include overlays to present data. Data gaps should be listed.

Response: Key findings are discussed on the previous investigation tables in each plan. Cross-sections with maximum concentrations have been added for the known disposal pits. A table (Table 2-4) has been added to Section 2 which summarizes the maximum concentrations of compounds previously detected in each location. The table in Section 2 also references where additional data can be located. Data gaps are discussed in the Problem to be Resolved section of the site-specific Data Quality Objectives Table.

Specific comments

1. Comment summary: The introductory notice states that views expressed in the SAP are those of the contractor and not the Air Force. The notice must contain Air Force conclusions and recommendations and should be removed.

Response: This notice, as written, is a requirement of the IAG.

2. Comment summary: A signature block for the responsible professional(s) should be included.

Response: The signature block has been added.

3. Section 1.2. Comment summary: State that QAPP additions will be adhered to by the RI contractor and whether the SOPs are new information or are included in the SAP.

Response: Text stating that the SOPs in Appendix B are amendments to the QAPP and will be followed has been included.

4. Page 4-3. Comment summary: It is unclear how increasing the MDRD to 50% will minimize the number of samples collected. The formula should be included.

Response: Since statistical sampling designs were not included in the Draft Final SAP, the 50% MDRD discussion has been deleted. Although the formula for calculating the MDRD has not been included, the procedure for doing so is outlined in Uncertainty Limits in Section 4.2.1.

5. Page 5.1-1. Comment summary: Information regarding why the IWL in IC 9 is no longer used should be included, if possible.

Response: The information has been included in the IC 9 Field Sampling Plan.

6. Page 5.1-1. Comment summary: The location of building 651 is not shown on Figure 5.1-1; therefore, the pertinence of this previous study cannot be determined.

Response: The building number has been added to the building.

7. *Overlay to Page 5.1-11. Comment summary: The overlay legend is mislabeled for the CROSS-SECTION and PREVIOUS SOIL GAS SAMPLE symbol.*

Response: The symbols have been corrected.

8. *Figure 5.1-2. Comment summary: Two sampling locations were omitted from the discussion and/or figure.*

Response: The sampling strategy has been changed; both the text and the figure have been revised.

9: *Table 5.1-3. Comment summary: Cyanide is identified as a contaminant of concern (COC) at PRL S-31 but is not included on Table 5.1.3.*

Response: Cyanide is not a COC for this location and has been removed from the discussion.

10. *Page 5.2-2. Comment summary: The incorrect number of borings was stated in the text for IC10.*

Response: The sampling strategy has been revised; both the text and the figure have been revised.

11. *Figure 5.2-1. Comment summary: The arrow to show the location of the "7-inch berm surrounding PCB storage area constructed in 1979" points to the storm drain line. Please correct the figure.*

Response: The figure has been corrected.

12a. *Figure 5.2-2. Comment summary: Location designation for IC10B05 should be corrected to IC10SB05.*

Response: The change has been incorporated.

APPENDIX D

Response to Comments on Draft Final OU C RI SAP

RESPONSE TO COMMENTS TO THE DRAFT FINAL OU C RI SAP

RWQCB

1. *Comment Summary: Samples collected from pits, drainages, and existing water courses should be analyzed for soluble metal and semivolatile organic compound (SVOC) concentrations.*

   Response: Samples will be collected for soluble metal analysis from native material beneath pits/landfills. These samples will be held in the laboratory pending results of total metal analyses. The sample beneath each pit/landfill which yields the highest concentration of total metals relative to the contaminants toxicity will be analyzed for soluble metal concentrations. (The concentration will be divided by the residential PRG to obtain a weighting factor. Weighting factors are summed for each constituent in the sample. The sample with the highest factor will be analyzed for soluble concentrations).

   Soluble analysis performed will include SW1311/SW6010 (ICP metals), SW1311/SW7060 (Arsenic), SW1311/SW7471 (Mercury), SW1311/SW7740 (Selenium). The shortest holding time for these methods, 28 days for SW7471, is sufficient to obtain results from total analyses, make comparisons to background, and determine which sample should be analyzed for soluble concentrations.

   Soluble SVOC analyses will not be performed in Phase I. The holding time for total SVOC analyses does not provide adequate time (14 days) to identify hot spots and select samples for soluble analysis.

   Soluble analyses for metals and SVOCs in sediments from drainages and existing water courses will be performed, if necessary, in Phase II once hot spots have been identified.

2. *Response to Comments, page 14, no. 2. Comment Summary: What indicators will be used to determine if metal and/or SVOC concentrations are a potential threat to groundwater?*

Response: To estimate potential threats to groundwater, the mass loss to groundwater and concentrations in the A zone after 30 or more years of migration will be calculated for SVOC concentrations and metal concentrations exceeding background. The calculation, summarized in the McClellan AFB Basewide RI Predictive Modeling Procedures Volume, will be based on the assumptions that the average pore water percolation rate under unsaturated (or saturated, where appropriate) conditions will be constant for 30 years and that the vadose zone leachate will mix with flowing, uncontaminated groundwater in the upper ten feet of the A monitoring zone during the 30 year period. As discussed in the Predictive Modeling Procedures Volume, if the calculated concentration exceeds groundwater background concentrations, MCLs, or risk cutoffs, more extensive evaluation of contaminant mass in soil and vadose zone characteristics will be required.

3. *Response to Comments, page 15, no. 3. Comment Summary: The rationale presented for determining when vadose zone modeling runs should be extended beyond 30 years is different than the rationale previously discussed. Why?*

Response: In previous discussions of simulated time intervals for vadose modeling, the use of a linear slope (concentration in water at capillary fringe versus time) value was considered. However, in reviewing the results of over 100 VAPOUR-T model results, it was evident that calculated concentrations of a VOC in leachate (at the capillary fringe) may approach the detection limit or the MCL with a variety of slopes (flat to steep) depending on site-specific conditions. Because of the difficulty in selecting one slope for each VOC, it seemed more appropriate to evaluate the leachate concentration at the end of the initial 30-year simulated interval. If the 30-year leachate concentration is 0.99 to 0.1 times the detection limit and increasing, the run will be extended. If the leachate concentration is decreasing or less than 0.1 times the detection limit, the run will not be extended.

4. *Response to Comments, page 22, no. 38. Comment Summary: In addition to Method SW6010, groundwater samples should be analyzed by the Method SW7000 series for arsenic, lead, selenium, and mercury.*

Response: The recommendation has been incorporated.

EPA

1. *EPA Draft SAP General Comment 5. Comment Summary: Drilling methods proposed for borings in OU C should be identified.*

   Response: Plate 2 has been added (in the back of the document) to illustrate the recommended drilling methods for borings in OU C.

2. *EPA Draft SAP General Comments 6 and 7. Comment Summary: Well purging procedures should include an indication that the issues presented in the above mentioned comments are being addressed in the QAPP.*

   Response: Well purging rates and procedures by current and accepted methods will be included in the forthcoming revision to the McClellan AFB QAPP.

3. *RWQCB Draft SAP General Comment 3. Comment Summary: Prospective RI contractors should be informed of holding time constraints on inorganic constituent analyses in borings where deeper samples will be held for analysis pending results of shallower samples.*

   Response: The comment has been incorporated.

DTSC

1. *Comment Summary: Rationale for spacing of soil gas sampling points along the industrial waste line (IWL) should be provided. Additional sampling points should be added where distances are large (e.g., greater than 300 feet).*

   Response: Rationale for spacing along pipelines is included on page 4-18 of the Draft Final report. This text has been updated to indicate that 100-foot spacing was used in areas where 1993 IWL inspection results indicate a moderate or high potential for leaks. Borings were also placed adjacent to all manholes, sumps, pipe intersections, known and historic leak locations, and cracks and breaks in the line. These criteria were set in the 21 January 1994 Draft OU C SAP comment review meeting with the regulatory agencies. At that time, the possibility that this strategy may result in wide

spacing (up to 400 feet) between boring locations was discussed. It was agreed that this strategy would provide adequate data for identification of leaks along the IWL. Additional borings along the IWL would be added in Phase II, if warranted, based on Phase I soil gas sample results.

2. *Comment Summary: The report does not specify where soil samples will be collected for total organic carbon (TOC) analysis.*

Response: As indicated on page 4-27 of the Draft Final report, samples will not be collected for TOC analysis. Results of sampling in other OUs across the base (including OU C1) indicate that the percent of TOC in soil is similar basewide and occurs in a small range (0.3% to 0.1%). Enough data exist from other OUs so that additional data from OU C is not necessary.

3. *Comment Summary: Cross sections in IC19 are mislabeled.*

Response: The figure labels have been revised.

4. *Comment Summary: At least 2 different geophysical methods should be used to delineate locations of buried drums. Borings should not be drilled in areas where drums may potentially be located. Potential buried drum locations should be trenched and the drums removed. An SOP for trenching in pits/landfills and removal of drums should be included.*

Response: Text has been added to Section 4.4 (Field Decisions) to address all of these issues as recommended. The SOP for trenching has been modified to include pit and landfill areas. An SOP for drum removal has been added to Appendix B.

5. *Comment Summary: Cross sections included in the Draft report and removed from the Draft Final should be re-inserted. The sections should be constructed to scale and contaminant data should be added.*

Response: As agreed in the 04 and 21 January 1994 meetings with the regulatory agencies, cross sections included in the Draft version were replaced with existing cross sections from the OU C PA and the 1986 McLaren Site Characterization report. These cross sections, although not to scale, were constructed for sites in OU C with a

substantial amount of existing data. Analytical data is shown on the sections. During the agency meetings, it was determined the value added from revision of cross sections in the Draft OU C would be minimal and that the existing sections from previous reports would provide sufficient information for this stage of the investigation.

6. *Comment Summary: Page 2-15 is missing from the document.*

   Response: The page was inadvertently omitted from one of the reports submitted to DTSC. The missing page has been submitted to DTSC for inclusion.

7. *Section 2.2.2, page 2-22 and Section 5.5, page 5.5.2. Comment Summary: Decommissioning plans for BW-6, BW-16, and boring DEB-C1 (possible conduits for contaminant migration) should be provided.*

   Response: Text has been added to Section 2.2.1 (Vadose Zone) and ICs 13 and 14 to indicate that these potential conduits will be investigated under the Well Abandonment Program at McClellan AFB. Base Well 16 is included in the current program, whereas, BW-6 and DEB C1 will be included in a subsequent phase of the program.

8. *Table 2-1, page 2-25. Comment Summary: Inorganic constituents previously detected in OU C should be included on Table 2-1.*

   Response: The tables have been revised to include inorganic constituents previously detected.

9. *Table 2-2, page 2-28. Comment Summary: BTEX compounds should be identified as contaminants of concern (COCs) at the former gas station in IC13.*

   Response: BTEX has been added to Table 2-1 and Table 5.5.3 in the report.

10. *Table 2-2, page 2-29. Comment Summary: Volatile organic compounds are not included as COCs for PRLs 63 and 64, however, VOCs are included for PRL 66B. These areas are drainages and, therefore, COCs should be consistent for the sites.*

Response: VOCs are a COC in PRL 66B because the sumps behind Building 722 may have released organic compounds to the soil. VOCs are not standard COCs for ditches since they have most likely volatilized to the air since their release. Standard COCs for sumps have been added to Table 4-11.

11. *Table 2-2, page 2-31 and 2-32. Comment Summary: The COCs for the IWL at PRL L-7C in IC18 and PRL L-7D in IC20 are not consistent.*

Response: The COCs listed for PRL L-7C have been modified and are now consistent with PRL L-7D.

12. *Table 2-2, page 2-34 and Section 5.17, page 5.17-1 and Table 5.17-2. Comment Summary: Tank 783 is listed as a waste fuel tank on Table 2-2, but is described as a waste oil tank in Section 5.17. The COCs listed may be incorrect if it is a waste oil tank.*

Response: Reference to the waste oil tank could not be identified in Section 5.17. The tank is a waste fuel tank as specified on Table 2-2. The COCs listed are therefore correct.

13a. *Table 4-11, pages 4-16 and 4-17. Comment Summary: Footnote "g" is not indicated on the body of the table. Please indicate the item to which the footnote applies.*

Response: Footnote "g" has been added to the appropriate item.

13b. *Section 5.3, pages 5.3-10 and 5.3-11. Comment Summary: The text should state why two of the three proposed sediment sampling locations in Magpie Creek will be analyzed for radionuclides and the third sample will not.*

Response: One sample will be collected adjacent to the radioactive storage area. The second sample will provide upstream (baseline) data for radionuclide concentrations in surface water. Analysis of the third sample, also upstream, for radionuclides is not necessary to make interpretations. The justification for radionuclide sampling at the two sediment sample location is provided on pages 5.3-2 and 5.3-3 of the Draft Final report.

14. *Section 5.12, pages 5.12-9 and 5.12-10. Comment Summary: The rationale for deleting a hand auger sample location east of Building 7602 that was included on handouts at a January 1994 meeting with the regulatory agencies should be included.*

    Response: At the request of Mark Malinowski and agreed to by the other regulatory agencies during the 21 January 1994 meeting, this preliminary hand auger location was removed. The sampling point was located in a grassy area where surface contamination is unlikely.

15. *Appendix B. Comment Summary: It should be stated in the Cone Penetrometer Testing (CPT) SOP if lithologic data and analytical samples will be continuously collected or only from discrete intervals. The SOP does not discuss how CPT holes will be calibrated.*

    Response: Lithologic data will be continuously recorded. Analytical data will be collected at the discrete sample interval specified for the boring on the associated sampling and analysis matrix table. Text has been added to the SOP to clarify this. The CPT rig will be calibrated adjacent to existing borings where lithologic data has been collected. Soil types across McClellan AFB are similar enough that calibration in each IC is not necessary.

16. *Appendix B. Comment Summary: Calibration efforts to check the accuracy of non-aqueous phase liquid (NAPL) screening methods are not specified in the SOP for Identifying and Taking Action for NAPLs during Subsurface Drilling.*

    Response: Twenty-five percent of the samples collected for NAPL screening will be sent off-site for confirmational analysis. Samples will be selected randomly so that a representative suite of concentrations for comparison will be obtained. Text has been added to the NAPL SOP to clarify calibration methods.

17. *Appendix B. Comment Summary: A grid spacing of 10 feet should be used in the acquisition of geophysical data. Geophysical methods other than magnetics and electromagnetics are not presented in the SOP. Ground penetrating radar (GPR) should be used to augment detection of underground storage tanks.*

Response: Grid spacing for geophysical surveys is dependent on the type of equipment used and the equipment specifications. The correct spacing will be determined once the equipment has been procured. If possible, grid spacings will be 10 feet or less. Electromagnetic and magnetic surveys were selected for detection of buried objects in OU C due to the types of debris anticipated (ferrous and non-ferrous material) and because these methods are not effected by radar. Magnetic surveys will be sufficient to identify buried tank locations. GPR surveys, previously conducted in OU C, have had limited success due to interferences with radar systems at McClellan AFB.

12b. Comment summary: A note in the legend of Figure 5.2-2 may be appropriate to indicate that 3 hand auger locations may be added based on field test results.

Response: The footnote has been added.

13a. Table 5.2-3. Comment summary: Borings SB1-SB7 identified in the Sampling Locations section should be changed SB1-SB6. Also, SB8 and SB9 should be changed to SB7 and SB8 for consistency with Figure 5.2-2 and Table 5.2-4.

Response: The sampling strategy has been revised; both the text and the figure have been revised.

13b. Comment summary: A footnote should be added to the table identifying the optional nature of the hand augers. Please include the rationale for not including confirmatory analysis by an off-site laboratory for the immunoassay tests.

Response: A footnote has been included on the Proposed Boring Figure to note that the hand augers will be placed only if surface scrape results warrant. This is also discussed in the text. Confirmatory analyses have been included in the Sampling and Analysis Matrix Table.

14. Table 5.2-4. Comment summary: A footnote should be added to Table 5.2-4 addressing the three optional hand augers.

Response: The hand augers have been added to the table.

15. Section 5.3.2. Comment summary: This section does not include designation numbers for proposed investigation locations. For consistency, these designated numbers should be added.

Response: The location numbers have been added.

16. Table 5.3-3. Comment summary: In Table 2-1, TPH is identified as a potential COC for Tank 737. Please indicate the rationale for not including TPH on Table 5.4.3 for Tank 737.

Response: TPH is included on the table.

17. Table 5.4-2. Comment summary: The text should be changed to identify the PRL as S-48 not S-46. The spacing criteria is inappropriate since the area is approximately 105' x 100'.

Response: The sampling strategy has been changed, and the text modified accordingly. The area is approximately 150' x 100'.

18. Figure 5.4-2. Comment summary: A location for IC12SB26 is not shown on this figure and should be added.

Response: The sampling strategy has been changed and the borings renumbered.

19. Page 5.5-1. Comment summary: The text of the fourth paragraph on page 5.5-1 is awkward. Clarify "open storage" and the section.

Response: The text has been modified. Open storage is uncovered storage.

20. Page 5.5-3. Comment summary: Criteria for terminating Boring B7 based on visual evidence should be stated.

Response: The sampling strategy for the boring has been changed. Samples will be collected below the anticipated depth of the bermed area.

21. Page 5.5-3. Comment summary: Table 5.5-3 indicates that groundwater samples will be collected from SB17, but the text does not mention this.

Response: The groundwater samples, which were in support of the investigation of IC 15, have been eliminated, and the table changed accordingly.

22. Page 5.5-7. Comment summary: The second bullet "Determine location priority" seems to be out of place based on like information included other tables.

Response: The bullets have been rearranged to remain consistent with the other Field Sampling Plans.

23. Page 5.6-2. Comment summary: This section number (6.5.2) should be changed to 5.6.2.

Response: The number has been changed.

24. Section 5.6.2. Comment summary: Please correct inconsistencies regarding the numbering of Magpie Creek sampling locations.

Response: The Magpie Creek sampling strategy has been revised. All sampling for the old Magpie Creek channel in IC 14 have been eliminated.

25. Table 5.7-2. Comment summary: Text states that judgmental samples will be placed at regular intervals along the levees separating the ponds. Please define "regular intervals."

Response: The sampling plan has been revised. No samples or borings will be placed along the levees except for soil gas samples from the dry monitoring wells already installed there.

26. Page 5.8-1. Comment summary: Text states that "the pond may have been used for creek water; however, this is uncertain." Does this mean that creek water may have been stored in the pond?

Response: Yes, creek water may have been stored in the pond. However, data regarding the settling pond at PRL 50 are sparse, and what was stored in it is not known for certain.

27. Figure 5.8-2. Comment summary: This figure appears to be out of sequence within the IC 16 Field Sampling Plan.

Response: The figure has been placed in the correct sequence.

28. Table 5.9-2. Comment summary: Please clarify whether the 100' intervals for soil gas sample collection are lateral or vertical.

Response: Borings will be drilled at a distance of approximately 100 feet away from one another (horizontally).

29. Table 5.9-2. Comment summary: The text states that soil samples will be collected from the surface to 5 feet BGS within the creek. Please define surface.

Response: The text has been modified to read: Soil samples will be collected from the creek bed to 5 feet below the creekbed.

30. Table 5.9-2. Comment summary: The statements in "Boundaries of the Study" and in "Decision Rule" bullets 4 and 5 appear to be contradictory.

Response: The decision rules regarding contamination greater than 30 feet BGS have been deleted.

31. Figure 5.9-2. Comment summary: IC17SB04 is depicted on subject figure as a reconnaissance boring, not a deep boring. Please correct the symbol used to identify this boring on section 5.9.2 and Table 5.9-3.

Response: The sampling strategy has been revised and the figure modified accordingly.

32. Section 5.10.2. Comment summary: The number of hand augers stated in the text, table, and shown on the figure is not consistent.

Response: The number of hand augers proposed has been revised and the text tables, and figures made consistent within the plan.

33. Comment summary: Table 5.13-3 is incorrectly numbered and apparently should be renumbered Table 5.11-3. Please define whether "100 foot intervals" are lateral or vertical.

Response: The table has been renumbered; borings are approximately 100-feet apart (laterally).

34. Comment summary: The text states "Soil samples will be collected from the surface to 1 feet BGS within the creek." should be changed to foot; define "surface."

Response: The text has been modified. Samples will be collected from the creekbed and 1 foot below the creekbed.

35. Figure 5.11-3. Comment summary: Are the southern boundaries of CS 11 and CS 13 known? IC19SB02 is mislabeled.

Response: The southern boundary of CS 11 was fairly clearly defined by previous investigations; the boundary is CS 13 is less clear. However, because the RI will conducted in phases, boundaries of the pits are not included in this Phase 1 SAP; rather, boundaries will be confirmed in Phase 2, Extent Determination. The borings have been revised and renumbered.

36. Table 5.11-4. Comment Summary: Previous studies indicated the presence of methane and phenol at the pits in IC 19. These analytes should be included as contaminants of concern.

Response: Methane gas is not a COC for IRP purposes; rather, it is a health and safety concern, and proper precautions will be taken to ensure any methane that is encountered does not ignite. Samples are being collected for TO-14 analysis to determine the presence of phenol.

37. Figure 5.12-2. Comment summary: Please clarify several inconsistencies between the text of the sampling plan and the figure.

Response: The sampling strategy has been changed and the text revised to be more clear.

38. Figure 5.13-2. Comment summary: The text states "Trenches C and D are intended to confirm or disconfirm previous geophysical evidence for the boundaries of the pit." Is there a question regarding the accuracy of the previous geophysical work? "Disconfirm" is not a word.

Response: As shown on Figure 5.13-2, previous geophysical investigations delineated the pit at CS 7 as trending northeast-southwest. However, during the McLaren investigation, the borings that encountered waste trend almost north-south. (These borings are shown on the figure with small circles around the dot that represents the boring.) The Air Force and

regulatory agencies, however, have subsequently determined by that trenches will not be dug in Phase 1 of the RI at these locations. *Webster's Ninth New Collegiate Dictionary* (Springfield, MA: Merriam-Webster, Inc., 1987) defines "disconfirm" as "to deny the validity of."

39. Section 5.13.2. Comment summary: Hand auger location numbers should be added to the text for consistency.

Response: The sampling plan has been revised. Hand auger numbers have been added to the text.

40. Table 5.13-2. Comment summary: Are 100-foot intervals horizontal or vertical? Clarify text regarding sample placement.

Response: Text has been revised to clarify that borings are approximately 100 feet apart horizontally. Soil samples will be collected from the waste material and from about 10 below the bottom of the waste.

41. Table 5.13-2. Comment summary: Will the lower boundary of the study (40 feet BGS) be adequate to satisfy the decision rule for determining contamination greater than 30 feet BGS?

Response: The decision rule has been changed.

42. Table 5.13-3. Comment summary: Since both lead and copper are potential contaminants of concern, copper should be added to the problem statement.

Response: Copper has been added to the problem statement.

43. Section 5.14.2. Comment summary: The text, tables, and figure seem to be inconsistent in their numbering of two hand augers referred to on page 5.14-2.

Response: The text, tables, and figure have been made consistent.

44. Section 5.14-2. Comment summary: Since both lead and copper are potential contaminants of concern, copper should be added to the problem statement.

Response: Copper has been added to the problem statement.

45. Section 5.14-2. Comment summary: The figure identified two locations as P53SB01.

Response: The figure has been corrected.

46. Section 5.15-2. Comment summary: Locations numbers should be added to the text for consistency. There is also an apparent discrepancy about the number of surface scrape samples.

Response: Sampling location numbers have been added to the text. The discrepancy about numbers has been resolved.

47. Section 5.16-2. Comment summary: Boring numbers should be added to the text for consistency.

Response: Sampling location numbers have been added to the text.

48. Table 5.16-1. Comment summary: The boundaries of the study and the decision rule appear to conflict. Please resolve.

Response: The decision rule has been changed.

49. Table 5.16-2. Comment summary: The analytical matrix and field specification tables are inconsistent with the boundaries of the study in the DQO tab with regard to depth.

Response: The tables have been made consistent.

50. Figure 5.17-1. Comment summary: Figure 5.17-1 appears to be out of sequence compared to the other FSPs.

Response: Because two figures (potential discharge and sampling location) are not necessary for this FSP, Figure 5.17-1 has been left as it is.

51. Page A-2. Comment summary: Will one monitoring well be sufficient to fill the data gap identified for PRL S-10? Where are the other monitoring wells? The plate seems to show PS10SB01 as a hand auger. Please clarify.

Response: One monitoring well has been deemed sufficient for this area for now; this can be reevaluated in Phase 2. The existing monitoring wells have been added to the plate, and the symbol for PS10SB1 revised.

52. Page A-2. Comment summary: The text and plate are inconsistent; IC19SB61 seems to be a monitoring well that will be installed in a cone penetrometer hole. Please clarify.

Response: The sampling strategy and strategy for monitoring well placement have been changed. Monitoring wells will be installed south of the IC 19 pits after HydroPunch samples are analyzed.

53. SOP for sampling groundwater with HydroPunch I and II. Comment summary: Please explain how a bailer can be used for HydroPunch II.

Response: The text does not imply that the inside diameter of the HydroPunch II sampler expands; the HydroPunch II sampler is larger than the HydroPunch I and can accommodate a 1-inch bailer. The text has been clarified.

54. SOP for sampling groundwater with HydroPunch I and II. Comment summary: Does "base" of the boring mean total boring depth?

Response: Yes. Text has been clarified.

55. SOP for perched water. Comment summary: The sentence, "At total depth of the perched water zone, lift the auger two feet and emplace a two-foot seal of non-beneficiated sodium bentonite chips at the base of the boring," can be misinterpreted. Do not use "base" to signify total boring depth.

Response: The text has been clarified.

56. SOP for trenching to determine pit, landfill, and creek boundaries. Comment summary: How will underground utilities be identified? What method will be used to mark these utilities?

Response: Geophysical methods will be used to identify underground utilities in areas to be trenched. The line's position, type, and depth (if known) will be marked with VOC free and lead free spray paint.

57. SOP for trenching to determine pit, landfill, and creek boundaries. Comment summary: Safety measures to keep people out of the trenches when work crews are not present are insufficient. Review applicable laws and regulations regarding open trenching.

Response: The SOP has been changed to read that, if the trench must be left open, OSHA or Corps of Engineers requirements, whichever is more stringent, will be followed.

58. SOP for cone penetrometer testing. Comment summary: How will the grout be pumped through the sounding rods while the penetrometer is being retrieved? Text implies these actions will take place simultaneously.

Response: The text has been clarified to remove the implication of simultaneity.

59/60. QAPP. Comment summaries: These comments refer to sample chain-of-custody and completeness objectives.

Response: These comments will be passed on to the people updating the basewide QAPP and will not be addressed here.

REGIONAL BOARD

General Comments

1. Comment summary: The RI should be conducted in a phased manner; the SAP should divide work into a phased approach based on priority. DQOs should be modified to meet this approach. Phase 1 sampling locations/sites should be prioritized so that funds will be spent first at the higher priority sites.

Response: The RI will be conducted in a phased approach; the SAP has been modified to include only Phase 1 sampling locations. The DQOs have been modified accordingly. As agreed at the January 21, 1994, agency meeting, all deep borings will be drilled first. Priorities for sites and ICs have been made outside the SAP.

2. Comment summary: No sampling is proposed for metals and semivolatile organic compounds (SVOCs) in their soluble concentrations. Results of the OU C1 investigation should be reviewed to determine if any trends are apparent between total and soluble concentrations.

Response: OU C1 data were not available during the preparation of the SAP. If Phase 1 data for metals and/or SVOCs indicate a potential threat to groundwater, samples can be collected during Phase 2 for soluble analyses.

3. Comment summary: The methods used to determine the potential for inorganic constituents to migrate to exposure pathways should be discussed, including what analytical methods will be used.

Response: This SAP outlines a Phase 1 RI. During Phase 1, only sources of contamination will be addressed. The potential for migration will be addressed in Phase 2. In areas where inorganic species are anticipated in the deep vadose zone, samples will be collected for analysis. These samples will be held pending results of shallower samples. If shallow samples contain concentrations above background, the next deeper interval will be analyzed. If concentrations are below background, deeper samples will not be analyzed. This will be an iterative process for each interval sampled for inorganic species analysis.

4. Comment summary: In presenting past sampling results, some concentration data for the COCs should be presented to justify the proposed sampling locations and constituents to be analyzed for.

Response: A table of maximum detected concentrations for each site has been included in the general section of the SAP (Table 2-4). The table includes compounds detected, the boring with the highest concentration, and depth at which the maximum concentration was reported.

Specific comments

1. Page 3-2. Comment summary: The first box in the column labeled "Secondary Release Mechanism" should also have an arrow pointing to the groundwater box under "Migration Pathway."

Response: The figure has been modified accordingly.

2. Page 4-1. Comment summary: The section needs to be modified in light of General Comment 1.

Response: The section on RI Decision Process has been modified to reflect a phased approach.

3. Page 4-11. Comment summary: The last line of Table 4-6 says that VOCs will be modeled for a minimum of 30 years. What are the criteria for extending that time? Also, what about non-VOCs?

Response: The table has been revised. Non-VOCs will be modeled using a simple analytical model for 30 number of years. If the model shows any contaminant reaching the groundwater at a concentration greater than or equal to 0.1 x the MDL, the model will be extended to 50 years.

4. Page 4-12. Under "Data Evaluation Boundaries," at what point in the VAPOUR-T model run will leachate concentrations be determined? Under "Decision Rules," include risk from non-VOCs in groundwater.

Response: Leachate concentrations will be determined every 5 years. Non-VOC decision rules have been added to the table.

5. Page 4-16. Comment summary: Should the decision box labeled "Surface Sampling" be limited only to surface sampling or should it include sampling at depth?

Response: No, the box should include deeper sampling as well. Screening methods could be used on deep soil.

6. Page 4-18. Comment summary: The last sentences states that the preliminary health-based Levels of Concern were used as a comparison concentration for the PCB curves. What concentration was used?

Response: The power curves have been revised The PCB curves now use preliminary remediation goals (PRGs) as a comparison concentration. The PRGs for residential soil (0.11 mg/kg) were used to be conservative.

7. Page 4-19. Comment summary. The second assumption found int he table states that the variability of contaminant concentrations in localized areas of OU C will be equal to the variability of inorganics in background. Does that assumption presume this is only true at sites where no released of inorganics have occurred? If so, then a release would be detectable that is above background concentrations.

Response: The second assumption presumes that the variability at a site is the same as that for background, whether or not a release has occurred. This assumption is a necessary function of the statistical approach, since the basis for comparison of site data to background includes both concentration and variability. The variability in the background data is high for most constituents, so the variability assumption may not be violated. However, if variability oat a site that is contaminated is much greater than background, it is likely that the concentration difference will be so large as to overwhelm the influence of variability on the outcome of the test. A non-parametric test may be used to statistically determine whether a difference exists between background and the site. In addition, if the variability assumption is violated, and the concentration difference is not great enough to statistically or judgmentally decide whether contamination exists, a two-sample power analysis can be performed that incorporates both the background data and the first set of RI data. This second power

analysis will be more powerful and likely to achieve the power, confidence, and resolution between background and a contaminant release.

8. Page 4-25. Comment summary: The last sentence states that the bottom of silty or clay layers will be targeted for soil sample collection. The OU B sample results showed that the VOC concentrations were higher at the bottoms of layers. Though non-volatile contaminants will likely adhere to fine-grained material, there could be a higher concentration of them at the upper portion of the layer.

Response: The sampling strategy has been revised. Soil samples will be collected: in discolored soil, if screening indicates the presence of a NAPL, or if the PID reading is greater than or equal to 500 ppmv.

9. Page 4-26. Comment summary: Text states that if unknown compounds are present, a minimum of 2 samples per boring will be submitted for TO-14 analysis. Will the samples be those with the highest concentrations or the greatest depth? Would there be occasion to want to analyze samples from the upper portion of the boring if they had high concentrations of unknowns?

Response: TO-14 samples will be submitted for those sample intervals near the top and bottom of the boring which has the highest concentrations to support vadose zone modeling and heath risk assessment. Text has been revised.

10. Page 4-26. Comment summary: Text says that samples will be collected from the bottom of fine-grained layers in soil intervals that have discolored soils, odors, etc. Staff recommends collecting the sample from within the discolored/odoriferous/debris soil. Contaminants may not have migrated to the bottom of the fine-grained unit.

Response: The sampling strategy has been revised. Soil samples will be collected: in discolored soil, if screening indicates the presence of a NAPL, or if the PID reading is greater than or equal to 500 ppmv.

11. Page 4-28. Comment summary: The verbiage in Figure 4-9 needs to be changed. The figure noes not take into account any lithologic data from nearby borings or CPT sampling done prior to the current boring that might help determine the interval.

Response: The start box has been reworded. Lithology will be determined using all available evidence.

12. Page 4-31. Comment summary: What about the migration of non-VOCs to groundwater?

Response: Migration of non-VOCs to groundwater has been added to the DQO table.

13. Page 4-32. Comment summary: Figure 4-11 asks the question, "can this analyte migrate to an exposure pathway?" Somewhere in the text there needs to be a discussion on how the migration/no migration determination will be made.

Response: Figure 4-11 has been deleted. The determination of migration potential has been referenced to the forthcoming background consensus statement.

14. Page 4-36. Comment summary: Shouldn't lead be included in Table 4-13?

Response: Levels of concern have been removed from the report. Preliminary Remediation Goals (PRGs) will be used as an initial *screening tool* to identify areas that may warrant further investigation or remediation. Residential PRGs will be used since they are the most conservative.

15. Page 5-4. Comment summary: The sampling depths presented on Figure 5-1 should also be contingent upon release location and source type. Instead of feet below surface, it should be feet below release location and/or bottom of source.

Response: The figure was left the way it was, because of the chance of volatilization to the atmosphere of VOCs and SVOCs in near-surface soils. If the source is below the surface, there is less chance of the loss of volatiles to the air than if the source is at the surface.

16. Page 5-5. A QAPP addendum for Method SW8260 should be presented, including detection limits. Has any consideration been given to using the 500 series for groundwater analysis?

Response: OU C RI SAP and Groundwater OU staff are in the process of determining the best method to use for groundwater analysis, so no QAPP addendum has been prepared yet. No consideration has been given at this time to 500-series methods.

20. Page 5.1-1. Text states that drains in the hazardous materials storage area connect with Magpie Creek and are normally left open. This should be addressed outside the CERCLA process.

Response: Comment noted.

21. Page 5.4-5. Comment summary: The site referenced in the Sample Design section should be PRL S-48.

Response: The table has been corrected.

22. P. 5.4-11, Table 5.4-3. Comment summary: Sample locations/depths listed for PRL L-7A also cover PRL 66/66A.

Response: A footnote has been added indicating this.

23. Page 5.5-3. Comment summary: The last sentence says that the borings will be drilled deeper if visual contamination is observed. What about field instrument readings or other non-visual soil contamination indicators?

Response: The strategy has been changed. The boring in PRL 54 will be drilled to 40 feet, below the anticipated depth of contamination in this "*bermed area*". The boring would be extended below 40 feet if the criteria established on Figure 4-8 are met.

24. Page 5.5-17, first footnote. Comment summary: The capacity of the tank(s) and/or whether they are still there should be known.

Response: The only evidence for the existence of the gas station is a 1945 CE drawing, and a report they may have been filled with sand and left in place. The capacity of the tanks and/or whether they are still in place are not known.

25. Page 5.6-1. Comment summary: Text states that an oil/water separator near Building 722 is reportedly connected to the IWL, but that this has not been verified. Text also states that the oil/water separator discharges to the ground surface in overflow conditions. This is unacceptable, and the separator should be plumbed into the IWL for all discharges. This should be handled outside the RI.

Response: Comment noted.

26. Page 5.6-3. Comment summary: It is proposed to sample around the waste tanks at the IWTP. Why are the process tanks not included?

Response: The other areas of the IWTP have been sufficiently sampled as part of the OU C1 investigation.

27. Page 5.6-3. Comment summary: It appears that boring SB40 is not within the old Magpie Creek channel.

Response: The reviewer is correct. Boring SB40 was intended to sample around the tank at Building 703; the text was misnumbered. However, the boring at Building 703 has been eliminated because sufficient sampling has been undertaken in this area in the OU C1 investigation, and the Magpie Creek strategy has been changed completely. No samples of the old Magpie Creek channel will be collected in IC 14.

28. Page 5.7-1, paragraph 3. Comment summary: Flow from PRL 28 can bypass PRL 60 if desired.

Response: Text has been amended to indicate flow can bypass PRL 60.

29. Page 5.7-2, paragraph 1. Comment summary: The effluent from the IWTP was discharged to the Sacramento Regional County Sanitation District prior to 1987. The discharge to the creek was terminated sometime between 1984 and 1985.

Response: Text has been so amended.

30. Page 5.7-3. Comment summary: The proposed sediment samples in Magpie Creek will be representative of recent deposits and the sources of any pollutants would be McClellan AFB and any source upstream of McClellan.

Response: The commentor is correct.

31. Table 5.7-3. Comment summary: How will sampling of soil as beneath PRL 60 be affected by high moisture and/or saturated conditions due to leakage from the basins?

Response: If the basins are in fact leaking, it may not be possible to collect soil gas samples.

32. Page 5.8-1, paragraph 3. Comment summary: Text says that from 1985 to 1989, the ponds (in IC 16) held effluent from the IWTP before it was discharge to Magpie Creek. The effluent was discharge to the Regional County Sanitation District, not the creek. The ponds only held effluent during high flow periods (rainfall events) since the discharge to the District was limited to 500,000 gpd.

Text has been amended to reflect this clarification.

33. Table 5.8-3. Comment summary: Staff recommends that analysis for metals include EPA 7000-series analysis for certain analytes, not just SW6010.
Response: For Phase 1, only SW6010 samples will be collected in Don Julio Creek. If results indicate possible contamination, 7000-series samples can be collected in Phase 2.

34. Page 5.9-9, Figure 5.9-2. Recommend sampling locations be added north of CS 67 and east of CS 43 to define the boundaries of those sites. Relocating borings would be preferred.

Response: Because the SAP has been revised to design a Phase 1 RI, borings to define the boundaries of sites or potential sources will not be included. Such sampling would be part of Phase 2.

35. Page 5.10-1. Comment summary: The text refers to a small sump west of Building 7606 that drains to an open ditch. The appropriateness of this sump and its discharge should be investigated outside the RI process.

Response: Comment noted; the sump is currently connected to the IWL, although it was not in the past.

36. Page 5.10-11. Comment summary: Staff recommends collecting surface samples for PRL 66C. This would be consistent with the proposed sampling regime for PRLs 66A and 66B.

Response: The sampling strategy has been revised to be consistent with the other drainage areas.

37. Page 5.11-2. Comment summary: SB28 should be SB29.

Response: Borings in IC 19 have been changed.

38. Page 5.11-20. Comment summary: Analysis of groundwater samples should speciate arsenic, lead, selenium, and mercury by methods other than SW6010.

Response: If Phase 1 results indicate possible contamination by these analytes, samples can be collected in Phase 2.

39. Page 5.11-12. Comment summary: Recommend a boring be located at the north end of CS 14 to define the northern extent of the pit.

Response: Borings in IC 19 have been changed. A boring will be drilled north of CS 14.

39. Table 5.11-4. Analysis of groundwater samples for metals should include 7000-series methods in addition to Method 6010.

Response: HydroPunch® samples for metals collected in Phase 1 will be only SW6010. If results indicate possible contamination, samples for metals can be collected from monitoring well for analysis by EPA 7000-series analyses.

40. Page 5.11-20. Comment summary: Boring numbers are off; there should be one fewer boring in the text.

Response: The sampling strategy has been changed; boring numbers have been changed accordingly.

41. Page 5.12-3. Comment summary: The arrow to PRL L-7D should point to the dashed line; it now appears to point to the storm drain.

Response: The arrow was pointing to the PRL boundary; however, that boundary was in the wrong place. The figure has been revised.

42. Page 5.13-4. Comment summary: Staff recommends analyzing the sample from the firing range by Method 8270.

Response: Samples from the firing range will be analyzed by Method SW 8270.

43. Appendix A. Comment summary: Text should be added as to how the proposed groundwater monitoring well locations and the Groundwater OU RI recommendations are related. Do the proposed locations satisfy the needs of the Groundwater OU? Are additional sampling points necessary?

Response: Sampling strategy for groundwater has been amended; specified text has been added. Many of the monitoring wells are those recommended in the Groundwater OU RI report.

44. Page A-2. Comment summary: Boring numbers in the text are incorrect.

Response: Boring numbers have been changed.

DTSC

General Comments

1. Comment summary: The RI field work should be done in phases.

Response: The RI of OU C will be done in phases. The SAP has been revised to be a Phase 1 SAP.

2. Comment summary: The IC cross sections would be more helpful if they were 11 x 17s. Previous data should be included.

Response: The cross sections as presented in the draft SAP have been eliminated. For those site at which McLaren prepared cross sections (in ICs 17, 19, and 21), those cross sections, with contaminant data, have been included. No other cross sections have been made at this time.

3. Comment summary. The document should describe the difference between "reconnaissance borings" and "deep borings."

Response: All borings have been renamed as either shallow (20 to 40 feet deep), and all deep borings are labeled groundwater borings.

4. Comment summary: The DQO tables should include the borings that will be used to meet the objectives.

Response: Boring numbers have been added.

5. Comment summary: Please include a table summarizing the analytical methods and chemicals identified by each method.

Response: Table 5-1 provides such a list.

6. Comment summary: Chrome VI should be speciated. This does not need to be done for all analyses.

Response: For sites where chrome is expected, some samples will be analyzed to speciate chrome VI.

7. Comment summary: Monitoring well locations proposed in the draft Groundwater OU RI report should be included in appropriate FSPs.

Response: Locations recommended in the Groundwater OU RI report have been included.

8. Comment summary: The Department does not support the use of HydroPunch directly through any of the confirmed sites in OU C.

Response: Borings drilled through the known waste pits will be cased to 10 feet below the waste. HydroPunch samples will be collected up- and downgradient of the pits.

DTSC

Specific Comments

1. Page 1-3. Comment summary: The RI/FS will also provide for identifying No Further Action/Investigation sites.

Response: The text has been changed accordingly.

2. Page 1-9. Comment summary: McClellan AFB has not identified a well decommissioning program for the next fiscal year. If wells are discovered and determined to pose a migration pathway, action must be taken to properly decommission the well.

Response: Since the comment was written, a well abandonment program has been funded for the fiscal year. Wells that require decommissioning will be addressed in that program.

3. Page 2-11. Comment summary: State the basis for "estimated permeabilities."

Response: Permeabilities have been estimated based on the USCS classification of borehole specific lithologies. Lithologies included in each of the permeability groups (high, moderate, and low) have been added in Section 4.

4. Page 2-25. Comment summary: In Table 2-1, the column labeled "wastes potentially released" seems to focus on current waste products. Specify if the buildings generated different wastes in the past.

Response: The list in the table is all-inclusive. The text has been modified to make this clearer.

5. Page 2-39. Comment summary: In table 2-3, are the concentrations for inorganics really in micrograms per kilogram?

Response: The table should have specified milligrams per kilogram for inorganics; this has been corrected.

6. Page 4-3. Comment summary: Include estimating mass of contamination in the "Decision to be made."

Response: Estimating mass has been included.

7. Page 4-4. Comment summary: Section 4.3.1. The OU C RI may also identify additional data gaps not identified in the Groundwater OU RI/FS.

Response: Text has been modified to include identification of data gaps not identified in the Groundwater OU RI/FS.

8. Page 4-4. Comment summary: Section 4.3.2. The Department questions the applicability of the 200-foot spacing for soil gas sampling. Additional soil gas samples may be required to fill in as the RI progresses.

Response: For Phase 1, soil gas samples will be collected at approximately 100 foot intervals, unless some other criterion was used (such as the location of known leaks along the IWL). If necessary, additional step-out locations can be sampled in Phase 2.

9. Page 4-5. Comment summary. In Figure 4-2, Decision Level II should indicate refinement of the conceptual model.

Response: The text has been modified to include this.

10. Page 4-29. Comment summary: Section 4.5.1. Indicate if UV light will be used to field screen samples for petroleum contamination.

Response: Ultraviolet light will be used to screen samples for NAPLs (see Appendix B).

11. Page 5-1. Comment summary: Section 5.0 should describe the purpose of reconnaissance and deep borings in general.

Response: The terms reconnaissance and deep borings have been eliminated; shallow borings (20 to 40 feet deep) will be used to help determine contamination from the surface to the boring depth; groundwater borings will be used to sample deep soil gas and groundwater and help determine whether those media are contaminated.

12. Page 5-4. Comment summary: Figure 5-1. Given that some monitoring wells in OU C have concentrations of metals above MCLs, the sampling depth interval for metals in soils should extend to groundwater.

Response: In areas where metal contamination is suspected to extent deep into the vadose zone, samples will be collected at depth and in the groundwater. Deep soil samples will be analyzed only if shallower samples contain concentrations above background.

13. IC 9. Comment summary: Provide contaminant data from previous work on cross sections.

Response: For most ICs, the cross sections have been eliminated. Contaminants detected at each site (and the highest concentrations reported) are included in a table in Section 4.0.

14. IC 10. Comment summary: How will swipe sample results be evaluated and aid in determining the type of action needed?

Response: The swipe samples have been eliminated.

15. IC 10. Comment summary. The hand auger sample should be included in Table 5.2-4. Reference point should indicate dependence on surface scrape results. The PCB samples should be included in Phase 1.

Response: Hand augers which are contingent upon screening results have been added to the text, table, and figure. PCB sampling is included in Phase 1.

16. IC 11. Comment summary: Why will Boring SB12 be drilled to groundwater?

Response: The strategy has been revised: the boring will no longer be drilled to groundwater; it will be drilled to 40 feet BGS.

17. IC 11. Comment summary: The Department recommends Phase 1 sampling include PRL 32 samples, four borings in PRL 56, and the Magpie Creek samples.

Response: The sampling strategy for IC 11 has been changed, and more nearly reflects the Department's recommendations.

18. IC 12. Comment summary: Initial sampling points along the IWL should be a 100' intervals and at known failure points.

Response: As discussed at the 21 January 1994 meeting with regulatory agencies and the Air Force, Phase 1 sampling along the inspected portions of the IWL will be at manhole and lift station location and locations of known cracks or leaks. The figure and text have been revised.

19. IC-13. Comment summary: Lithologic and contaminant data from previous investigations should be included in the SAP. Emphasis should be placed on finding and evaluating BS-16; if necessary, abandonment should be included. Only four of the proposed seven Magpie Creek borings should be included.

Response: As discussed at the 21 January 1994 meeting with regulatory agencies and the Air Force, previous lithologic data for IC 13 will not be included. Previously detected contaminants are listed in Section 2 (including maximum concentration, boring and depth at which the highest concentration was detected, and a reference to where additional

information can be obtained). Key findings of previous investigations are included in the Previous Investigations Table in the site-specific FSPs. The sampling plan for the old Magpie Creek channel has been revised; two trenches will be dug to find the channel, and samples will be collected from the former creekbed surface and below the former creekbed.

20. Table 5.5-3. Comment summary: why is a water sample being proposed so close to Monitoring Wells 128, 129, and 130?

Response: The water sample has been eliminated.

21. IC 14, page 5.6-1. Comment summary: Without the lithologic and contaminant data from previous studies at PRLs 17, 20, 21, 41, 63, and 64, the Department is reluctant to comment on additional proposed borings or sampling.

Response: As agreed in the 21 January 1994 meeting, lithologic data will not be presented (except in the known pits in ICs 17, 19, and 21). The maximum contaminant concentrations and where they were reported during previous investigations are shown on Table 2-4 for each location. Key findings of previous investigations are summarized on the Previous Investigation Table in each FSP.

22. IC 15. Comment summary: For Phase 1, the Department recommends reducing the number of sediment samples in PRL 60; some should be analyzed for speciated hexavalent chrome. How will sampling be performed to minimize disturbance to the sediments? Include the proposed monitoring well included in the Groundwater OU RI/FS report.

Response: The number of sediment samples in PRL 60 has been reduced by about half. No speciation for hexavalent chrome will be conducted in Phase 1; if SW6010 analyses indicate total chrome above sediment background concentrations, speciation can be conducted in Phase 2. Appendix B discusses how sampling of the pond sediments will be conducted. The monitoring well has been included as SB3.

23. IC 16. Comment summary: The Department recommends reducing the number of sediment samples in PRL 51; some should be analyzed for speciated hexavalent chrome. How will sampling ve performed to minimize disturbance to the sediments?

Response: The number of sediment samples in PRL 51 has been reduced by about two-thirds. No speciation for hexavalent chrome will be conducted in Phase 1; if SW6010 analyses indicate total chrome above sediment background concentrations, speciation can be conducted in Phase 2. Appendix B discusses how sampling of the pond sediments will be conducted.

24. IC-17. Comment Summary: The Department recommends that Phase 1 borings include only the borings within the Confirmed Sites. Identify the location of MW35S on Figure 5.9-2. Previous data should be presented.

Response: Phase 1 borings within the Confirmed Sites have been included. MW-35S has been added to Figure 5.9-2. Cross sections of each confirmed site, including positive analytical results, have been added.

25. IC 18. Comment summary: The sampling interval along the IWL should be 100 feet and at known leaks. the Department does not recommend soil gas sampling at depths less than 15 feet BGS along the IWL.

Response: As discussed at the January 21 meeting, Phase 1 sampling along the inspected portions of the IWL will be at manhole and lift station location and locations of known cracks or leaks. The shallowest soil gas sampling along the IWL will be 20 feet BGS.

26. IC 19. Comment summary: Department recommends Phase 1 sampling include samples within the CSs and fire training areas.

Response: Such samples are being collected.

27. IC 20. Comment summary: The sampling interval along the IWL should be 100 feet and at known leaks. the Department does not recommend soil gas sampling at depths less than 15 feet BGS along the IWL.

Response: As discussed at the January 21 meeting, Phase 1 sampling along the inspected portions of the IWL will be at manhole and lift station location and locations of known cracks or leaks. However, the IWL in IC 20 has not been fully investigated for leaks. In

sections where the potential for leakage is not known, borings will be drilled 100 feet apart. The shallowest soil gas sampling along the IWL will be 20 feet BGS.

28. IC 21. Surface geophysics should be used to locate drums of solvents reportedly disposed in CS 7. The Department does not support drilling through CS 7 at this time.

Response: As agreed at the January 21 meeting, borings drilled through CS 7 will be cased to 10 feet below the pit material to prevent cross contamination.

29. PRL 53. It is doubtful that a single sediment sample in the creek is appropriate for evaluating discharge from PRL 53.

Response: Sediment sample results will be used in conjunction with the sediment sample results from other ICs and with surface scrape results at PRL 53, to determine whether contaminants from PRL 53 have contaminated creek sediments.

DTSC (Mary Scruggs)
General Comments

1. Comment summary: The report should be signed by a California Registered Geologist.

Response: The signature page has been included.

2. Comment summary: Historical data used to select sampling points should be presented on maps and/or cross sections. Th. conceptual model should be updated as data become available.

Response: Cross sections with contaminant concentrations for sites with a multitude of existing data (ICs 17, 19, and 21) have been added. A maximum concentration table has been added to Section 2 (Table 2-4) which indicates the boring and depth at which the highest concentration was reported for each compound at each site (excluding metals). The table also references where complete analytical data can be obtained (by report title and page number). Conceptual models for the sites will be updated as additional data is collected. This is discussed in Section 3.4, Updating Conceptual Models.

3. Comment summary: Symbols which indicate what data will be collected in each boring should be added to the proposed sampling location figures.

Response: The symbols have been added.

4. Comment summary: Selection criteria for analyses should be explained in the text and applied consistently.

Response: Standard suites of contaminants at the different source types in OU C have been established on Table 4-11. The standard suites were consistently applied, exceptions were noted in the individual field sampling plans.

5. Comment summary: Cross sections should be drawn to scale.

Response: As agreed in the 04 January 1994 meeting with the Air Force and regulatory agencies, all cross sections presented in field sampling plans of the Draft OU C RI SAP will

be deleted and replaced with existing cross sections prepared in the 1986 *Technical Memorandum for the Shallow Investigation Program in Areas A, B, C, and Other Sites* and the 1992 *Operable Unit C Preliminary Assessment.*

6. Comment summary: Selection criteria for physical parameter sample collection and the intended use of the data should be included in the report.

Response: Physical parameter sampling criteria and data use has been included in Section 4.4.

7. Comment summary: A table should be added that indicates the recommended analytical methods and method number for all proposed analyses.

Response: Table 5-1 includes this information.

8. Comment summary: Criteria for metal analyses should be included. Each site should be reviewed with respect to inorganics and revisions made to the proposed analytical suite as necessary.

Response: The standard suite of contaminants anticipated at the different site types (Table 4-11) includes inorganic species. Each site was reviewed individually, however, to determine if analyses should be added or deleted from the standard suite. Exceptions are noted in the individual field sampling plans.

9. Comment summary: The criteria for cyanide analysis should be included. Each site should be reviewed and revised as necessary with respect to cyanide.

Response: Cyanide is a contaminant of concern in the known disposal pits/landfills. Each site was reviewed to determine if cyanide analyses should be included. Text has been revised to include a discussion of cyanide where necessary.

10. Comment summary: Groundwater flow directions should be indicated on the site-specific figures.

Response: Flow direction arrows have been added.

11. Comment summary: Analytical methods are not always referenced appropriately and should be corrected.

Response: The change has been made.

12a. Comment summary: Reduce the sampling and analysis frequency in the upper 5 feet to optimize RI cost.

Response: One sampling interval has been deleted from the plan in the upper 5 feet of soil.

12b. Comment summary: Cost saving measures such as analyzing metals collected at depth could be obtained if the sample uphole does not contain metals at concentrations of concern.

Response: This recommendation has been incorporated.

13. Comment summary: The title of the SOP for preventing the spread of NAPLs during subsurface drilling is not accurate. The title should state the SOP presents the methodology for screening NAPLs. Detection levels, calibration procedures, and method limitations should be included. Borings where NAPLs are encountered should be to a SVE well.

Response: The comments have been incorporated.